RAILROAD GAZETTE

SATURDAY, DECEMBER 23, 1871.

IMPROVED TOOLS FOR THE LATHE.

A number of improvements in tools, cutters and holders for lathe work, and in apparatus for drilling, boring, facing, turning, &c., have been recently patented by Mr. J. Snowdon, engineer, which the following description, with annexed illustrations, will sufficiently explain. The primary part of the invention consists in an improved method of constructing and arranging tools and holders, by which a considerable saving of metal is effected, and the tools are held more securely in the holders, or in the chucks of the machines in which they are employed. This tool or cutter-holder is made preferably of wrought iron or malleable cast iron, with a shank to be inserted and fixed in the socket or chuck of the drilling, boring or other machine by which it is made to revolve. At the end of the said shank one or more arms project at right angles therefrom, in which are made suitable recesses to receive the separate tools or cutters intended to operate on the material under treatment. Mr. Snowdon prefers to arrange these cutters (which are made of steel) in the tool-holder in such a manner that they shall act by successive steps, the outermost cutter being somewhat farther advanced than the others in order that the material shall not first be removed from the center, thereby preserving to the last moment the guiding power of the central guide-pin or drill, which is placed and secured in a hole drilled up the center of the tool-holder instead of being made solid with the steel tool or cutter. The separate tools or cutters in the recess of the tool-holder are fixed by means of wedges made of half-round iron or steel.

In some cases it is convenient to form the tool-holder with a boss instead of arms, as before mentioned, provided with a recess or recesses to receive the tools or cutters, provision being made for the insertion of the retaining wedge in each case. When necessary the tool-holder is prevented from turning in the socket or chuck of the machine in which it is used by forming a groove or recess across the face of such socket or chuck, and making the shank of the tool-holder with one or more arms adapted to take into the said groove on the socket or chuck, by which means it is forced to turn therewith more certainly than when dependent only upon a set screw or feather.

In the accompanying engraving fig. 1 represents a front view partly in section, a side view and view of under side of a tool-holder and cutters, suitable for drilling and recessing at same time. The tool-holder *A* the inventor prefers to make of wrought-iron or malleable cast-iron. It is made with a projecting part or arm *B*, in which is formed a recess *C*, placed obliquely with regard to the center pin or drill, as shown. The recess receives the steel cutter *D* (shown in dotted lines in the front view and removed from the recess in the view of under side), which is secured therein by the half-round wedge *E*. *F* is the central pin or drill secured by a set screw or otherwise in a hole drilled up the center of the tool-holder. The upper end of the tool-holder is adapted to fit into the drill box or chuck of a drilling machine or lathe. The tail-piece *G* is formed on the upper end taking into the rectangular slot therein.

Fig. 2 represents a partial section, side elevation, and under side view of a similar tool-holder and cutters adapted to cut holes in the tube plates of boilers, holes for ship work and other similar purposes. Similar letters of reference refer to the similar parts. The cutters are arranged to cut an annular groove, the central drill steadying the holder as the work progresses. They may be adjusted to cut holes of various sizes by being moved in the recesses to or from the center and fixed in any required position by wedges *E* and packing strips *E* 1, as shown in the under side view, or if preferred by means of set screws, as shown in dotted lines. In this example, two arms, *B*, *B*, are shown, but any other convenient number may be used as the dimensions or character of the work may require.

Fig. 3 represents similar views of a tool for drilling, facing and recessing, the center drill, cutters and wedges being shown in dotted lines, which also show how the sizes and positions of cutters may be regulated to suit a certain range of sizes of holes, the outermost cutter being the most advanced when it is intended to cut through, say, a plate, so as to retain to the last moment the guiding power of the central guide-pin or drill. In order to compensate for the wear of the central drill the bolt and long nut *H* may be inserted loosely in the central hole above the drill. As the drill wears, the bolt may be unscrewed more or less from the nut, and the cutting edge of drill thus kept out to the proper distance. This figure also illustrates the method employed for preventing the tool-holder from turning in the socket or chuck of the machine in which it is used. *I* is a cross-head formed in one piece with the tool-holder, intended to take into a recess formed across the face of the socket or chuck, the sides of which, acting against the cross-heads, relieve the set screws from any strain, so that they are only required to prevent the tool-holder from falling out of the socket.

Mr. Snowdon also patents tools for boring holes of large size and great depth, as in armor plates for instance; a pin or nipple drill for facing or recessing, by means of which a great amount of material may be removed without making a deep center hole; a tool for rounding heads and points of bolts in the lathe, or the drilling or screwing machine, which is also specially suitable for cutting such things as the pintles of rudders; a cutter block for moulding, tenoning, planing and other wood-working machines, and sundry other modifications.—*The English Mechanic.*

Contributions.

LOCOMOTIVE PROPORTION.

[Paper, by M. N. Forney, Mechanical Engineer, read before the Civil Engineers' Club of the Northwest, December 11, 1871.]

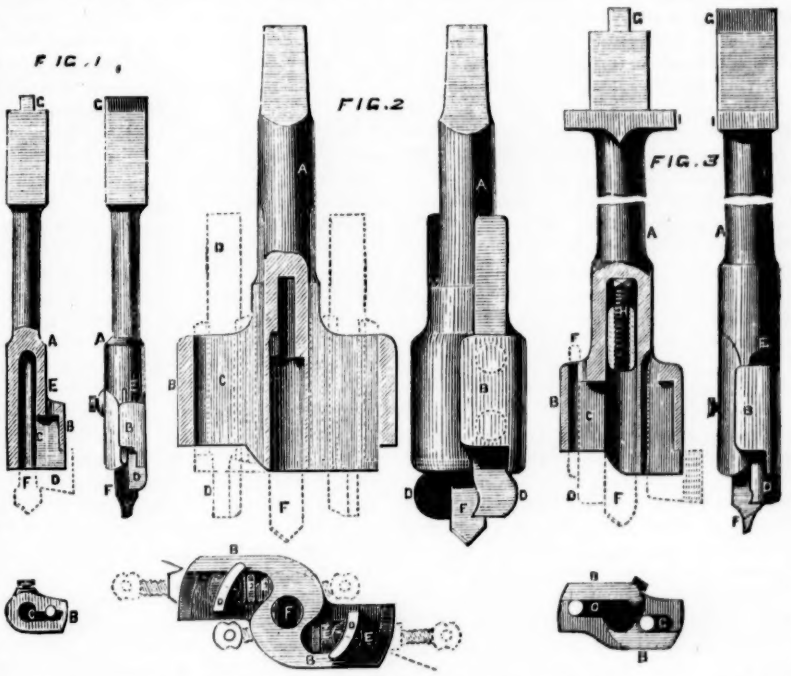
To proportion locomotives so as to get the best and most economical service with the least expenditure of money and material is a problem which has engaged the earnest attention of nearly all railroad engineers from George Stephenson's time to the present day. Aside from the mere mechanical appliances, there are more elements which must be taken into consideration than at first sight appear. To a very great extent the questions which arise are those which refer to the proportion and relation of parts to each other, and it will be found that this mutual dependence is much closer than is ordinarily supposed.

In the first place the total weight upon the driving-wheels must be governed by the loads to be drawn and the grades to be overcome. Secondly, the weight on each wheel will be limited to a great extent by the weight of the rails with which the road is laid. Thirdly, the diameter of the wheels will depend upon the speed. Fourthly, the size of the cylinders will be governed by the diameter of the driving-wheels and the weight they carry. Fifthly, the capacity of the boiler will be dependent upon the size of the cylinders in relation to the driving-wheels and to the speed of the train.

In the proportion of these parts the most diverse practice exists. What is proposed in this paper is to show what are conceived to be the reasons which should govern the proportion of the parts referred to.

As an illustration, we will suppose that we have a road with grades of thirty feet per mile, and that we want locomotives to take 30 ordinary loaded box-cars up such grades. Taking the weight of the cars and the tender at 40,000 pounds each, we have a total load of 1,240,000 pounds, or 553¼ tons (of 2,240 pounds). Taking the train resistance on a level and straight line at 6¼ pounds per ton, and adding it to the resistance due to gravity, we have a total of 19¼ pounds per ton, or 10,655 pounds. If, now, we assume that the adhesion of the engine will be 600 pounds for each ton it carries, we will require 17⅞ tons, or 39,760 pounds, adhesive weight on the drivers to do the work proposed. For the sake of even figures we will call it 40,000 pounds, which is about the weight that is carried on the four driving-wheels of ordinary American locomotives, whose total weight is 60,000 pounds. Such engines are usually provided with wheels 61½ inches in diameter and 16x24-inch cylinders, and we will assume this to be the best proportion.

If now we divide the number of cubic inches contained in the spaces swept by the two pistons (equal to four times that of one cylinder) during one revolution of the driving-wheels, by the circumference of the latter in inches, we will have the amount of steam expended for each inch that the locomotive is propelled by the revolution of the wheels when they do not slip. The cubical contents of a cylinder of 16 inches in diameter and 24 inches stroke equals 4,825 inches. As each piston sweeps through the cylinder twice for every revolution, the steam consumed is four times 4,825, or 19,300 inches, which, divided by the circumference of the driving-wheels, or 193.2 inches, will give, within a very small fraction, 100 cubic inches of cylinder capacity for each inch of the circumference of the driving-wheels. In order to designate this quantity, we have ventured to name it the modulus of propulsion. It is thought that it furnishes the most exact and accurate expression for the cylinder capacity of locomotives, as it takes into account all the dimensions of both the cylinders and wheels, and shows at a glance the exact relation of the capacity of the one to the other. If the driving-wheels were 55½ inches in diameter instead of 61½, the cylinder capacity would be 110.7, or more than ten per cent. greater than in the other case. The cylinder capacity of engines with 50-inch driving-wheels and 15x22-inch cylinders is as great as that of engines with 61½ inch wheels and 16x24-inch cylinders. Of course if the weight on the driving-wheels is increased or diminished the cylinder capacity should be changed in the same proportion. To maintain the proportion indicated by the preceding considerations, the following rule has been constructed: "Multiply the total weight on the driving-wheels in tons (of 2,000 pounds) by 5, and then by the circumference of the wheels in inches, and divide by 4. The result will be the capacity in cubic inches of each cylinder." Knowing this, it is of course easy to deduce the diameter from the stroke, or *vice versa*.



Having determined from ordinary practice what proportion the size of the cylinders should bear to that of the driving wheels and the weight they carry, let us now consider the proportion the boiler capacity should bear to that of the cylinder, or rather to the modulus of propulsion. It is hardly necessary to say to my hearers that the amount of steam generated in proportion to the heating surface is much greater in locomotive boilers than in any other kind. To produce combustion which will be sufficiently active to generate the requisite quantity of steam, the fire must be stimulated by the blast created by the exhaust steam to a degree unknown in almost any other kind of boilers. So rapid is the movement of the products of combustion that a smaller proportion of the heat is imparted to the water contained in the boiler, and consequently a less amount of water is evaporated in proportion to any given amount of fuel than in boilers in which combustion is less violent. The combustion is also less perfect, because the strong draft does not allow time for a perfect combination of the gases which produce combustion. Now, the smaller the boiler, or rather the larger the amount of steam which must be generated in a given time in proportion to the heating surface, the more must the fire be urged; and, therefore, the smaller the boiler in proportion to the work it must do, the less will be its economy. In order to produce a rapid combustion in a small boiler, it is necessary to contract the exhaust nozzles in order to create a draft strong enough. In doing this the back pressure on the pistons is very much increased, and when the blast becomes very violent large quantities of solid coal are carried through the tubes and escape at the smoke-stack unconsumed. At the same time large quantities of unconsumed gases escape, because there is not time for combustion to take place in the fire-box. The fact that with a violent draft the flame and smoke are in contact with the heating surface for a sensibly shorter period of time also has its influence; as less heat will be imparted to the water if the products of combustion are only $\frac{1}{10}$ of a second instead of $\frac{2}{10}$ in passing through the tubes.

There is another consideration which should be taken into account in this connection, which is, that if a boiler is so small that it is worked nearly up to its maximum capacity at all times, it will be impossible to accumulate any reserve power in it in the form of water heated to a high temperature to be used as occasion may require. With a boiler having a great amount of heating surface and capacity for carrying a large quantity of water, the latter can be heated at times when the engine is not working hard and the surplus used when it is most needed. We will suppose that to pull a train of 30 cars on a level we must evaporate 250 pounds of water per mile. On a grade of 30 feet per mile the resistance will be three times what it is on a level; therefore the boiler

must evaporate 750 pounds of water per mile on the grade in order to pull the train. If now we have a boiler with capacity for carrying a very large quantity of water, we can heat 500 pounds per hour on the level, 250 of which will not be needed. This can gradually be accumulated, so that after running four miles on a level the boiler will have 1,000 pounds of surplus hot water. If now on going up the grade the same amount of water is evaporated that was heated on the level, and 250 pounds of the surplus be used, the boiler will be doing no more work on the grade than it did on the level, although three times the quantity of steam is used. If, on the contrary, the boiler is so small that little or no surplus heated water can be accumulated, then we can heat water only as the steam is used, or at the rate of only 250 pounds of water per mile on a level, and therefore must evaporate 750 pounds per mile on the grade.

Or, in other words, with the smaller boiler, we must evaporate more water per mile on the grade than with the larger one. To do so it must be forced up to its fullest capacity and the fire stimulated to such a degree that great waste will result from the imperfect combustion of coal and smoke, and loss from back pressure caused by contracting the exhaust, in order to produce a blast strong enough. We are therefore led to the conclusion that the larger the boiler the more economical will be its performance, an inference fully sustained by practice. In proportioning locomotives it is important to bear this fact in mind, especially when any attempt is made to reduce their dead weight.

We have shown that to pull a given load a certain amount of adhesion is requisite. From existing practice we have deduced the cylinder capacity, or what we have called the modulus of propulsion, which should be supplied for any given weight in the driving wheels. Now if existing practice is right in this matter, the considerations which have been given will determine the cylinder capacity in any given case. We assume that it is right, and regard any discussion of it as foreign to our present inquiry, and on that assumption we draw the inference—based upon present practice—that any greater amount of adhesion or weight on the driving wheels in proportion to the cylinder capacity is not desirable. It is not assumed that the proportion of cylinder capacity to the amount of weight on the driving wheels is not a suitable subject for consideration, but only that before it can be shown to be true of a style of engine different from that in ordinary use, it must first be shown that our present practice is wrong. The element of speed is also for the present left out of the discussion, and what is said relates only to such engines as are used for ordinary freight traffic.

It has also been shown that the larger the boiler capacity the more economical will be its working. With these principles as premises, let us see what are the limitations in the way of a reduction of dead-weight; and before it is assumed—as it often is—that it is desirable to carry the whole weight of the boiler, engines, fuel and water on the driving wheels, let us find out what will be the result if we do so.

Taking the best American locomotives, with 16x24-inch cylinders, and what are called 5-feet driving-wheels, we find they have boilers with about 1,000 square feet of heating surface. Such a boiler with all its attachments, including safety-valves, whistle-cocks, gauges, steam-pipes, throttle-valves, smoke-stack, grates, ash-pan and lagging, weighs, full of water, about 25,000 pounds. The other parts of the engine, including all the machinery, but excluding the truck, weighs 30,000 pounds. The tank alone will weigh 3,500 pounds, 1,800 gallons of water will weigh 15,000 pounds, to which add 6,000 pounds of coal and the weight of two men, and tools, etc., which we will call 500 pounds, and we have:

Boiler	25,000 lbs.
Engine and machinery	30,000 "
Tank	3,500 "
Water	15,000 "
Coal	6,000 "
Men and tools	500 "
Or a total of	80,000 lbs.

—which is just double the amount of adhesion which, as ordinary practice indicates, can be operated to advantage with the modulus of propulsion and the boiler capacity at present used. If 10,000 pounds is the maximum load which can or should be carried on one wheel, then eight wheels is the smallest number on which the weight of our engine can be carried. It may be said with some truth that the weight of some of the parts could be materially reduced without lessening their strength or efficiency. Let us see how much reduction could be made.

The boiler might, perhaps, with improved design and material, be reduced 20 per cent., or 5,000 pounds, and still retain the same amount of heating surface and water capacity. By using smaller driving wheels, the cylinders, with the same modulus of propulsion, would be of smaller size: consequently they, as well as the wheels, connections, frames, and in fact all the other parts of the machinery, could be reduced in size and yet have the same tractive power, and relatively equal strength. We will suppose this reduction to amount to as much as one-third of the weight of the engines and machinery. We would thus save 10,000 pounds. Neither the weight of tank, water nor coal can be lessened without using the arrangement for taking up water while running, which, it is thought, none of my hearers would regard as practicable in any but very exceptional cases. No way, excepting Banting's system for reducing corpulency, is known by which the weight of the locomotive runner and fireman can be lessened. With a liberal estimate, therefore, the only reduction which it seems possible to make will be 5,000 pounds in the boiler and 10,000 in the machinery, which would reduce the total weight to 65,000 pounds, which is still 25,000 pounds greater than the requisite amount of adhesion which, as practice has indicated, can be utilized to advantage with the sizes of cylinders and boilers we are considering. Our conclusion, therefore, is, that with the materials now in use and the present knowledge of the construction of the machinery of locomotive engines, it is impracticable to carry the whole weight of the machine, including fuel and water, on the driving wheels, unless our present practice is wrong, and less cylinder and boiler capacity in proportion to the adhesive weight is desirable.

EXPERIMENTS IN TRACK-LAYING.

To the Editor of the Railroad Gazette:

The subject of oscillation receives on an average as much attention as any other detrimental action peculiar to railroads. The different usual causes are generally correctly sketched out and logically reduced to result, and the subject thus properly treated, could we regard the substructure as permanent. But there is another cause for great side motion which I have never as yet seen mentioned, which is apparently equal to all the other causes, and, judging by the shocks as realized by the human body, greater than all combined in detrimental effect. When a "foreman on track" beds a tie equally from end to end, he inaugurates the cause, because then the stability of the earth under the ends of the tie is less than that under the middle. The regular causes of oscillation—the working of the engine from side to side, the general staggering gait of a train, throwing its weight for a little while upon this rail, and then for a little upon the other—are another step toward detriment, working the earth from the ends of the ties outward, or toward the middle, at which latter point a hard knob or hillock is soon formed, when trains with reverse periods of oscillation have successively passed. Two signs of this phenomenon, then, meet the eye of even a careless spectator. First, the "squirting" of water in wet weather from under that end of each tie upon which that particular train happens to impinge most; and secondly, the universal breaking of ties across the middle as soon as they become sufficiently unsound. We may then easily conclude that some advantage can be gained from an increase of hardness or firmness of substructure, made by excessive "tamping" immediately beneath the rails. Now, this is generally admitted. Yet the difficulty still exists; still the ties in wet weather throw the water which collects in the hollows formed by the beating of their ends upon the ground, whenever the engine or train has "lunged" in that direction; still are they broken across the middle, as a rule, in marked numbers along every Western road; and still cars roll down upon one side and then with a rebound repeat the offense upon the other, without measurable mitigation. The writer (weight about 150 pounds) has by jumping produced a perceptible "see-saw" upon as nice a bit of track as could be seen in the country, and felt suggestively what five tons, vigorously worked by a fifteen-inch cylinder, might effect.

It is now nearly fifteen years since the writer was asked by a friend, then Chief Engineer upon an important Western road, to overlook the laying of some 110 miles of track, especially in regard to cost and to each division being rapidly brought into the proper condition to be of use to the transportation department. Practiced at that time only to the careful laying of track upon a ballasted surface, it became necessary, in the first place, to learn the modifications required to adapt the same general principles to earth substructure. Fortunately, from the foreman to the water-boss, the party were all first-class men, and thus good information was readily attained. The management of the work was then arranged in this wise: Party ahead under contractors surfacing up roadbed, costing about $100 per mile; with the boarding cars, boss and tie layers. These were provided with measuring poles, straight-edges, mauls, shovels and picks. The mode of work was as follows: Joint and center tie-layers, with measuring pole, shovel, pick and maul; intermediate tie-layers with same tools (except pole), and a straight-edge in addition, to each trio. With each two the following operation seemed necessary: Pick was stuck into one end of the tie, or it was lifted up and thereby brought to its place. Then, one end of the tie was held suspended over its intended site by the pick in the hands of one man, while the other went out to the side for a shovel full of earth. This earth was thrown under so as to form a conic frustrum upon which the tie was then dropped; some sighting and consultation between the two men, and more earth brought as the result of the deliberation; at last the straight-edge and maul were used, and—if there was no error—one end of the tie was considered laid. Then followed the adz-man; then the horse iron-truck, and the iron was "heeled" and dropped. Then the spike-dropper fulfilled his office, and the spikers; and when the track was laid it rested upon those little hillocks of earth described as formed at the ends of the ties. Now this track was very smooth when freshly laid, but became very uneven when run over by the train once or twice, and its peculiar defect was a marked rise *at the joints*, and a corresponding depression *irregularly* formed between them. If this were not a common phenomenon upon new track its occurrence might well be doubted, for the joints—especially a chair joint such as we used—should be the weakest place, and therefore after use the most depressed. But the mystery becomes satisfactorily solved when we reflect that in thus working each man does duty in proportion to his individual skill, each rise upon the rail then marking a well-rammed tie and a good trackman, and each hollow an inexperienced or weak man. The usual superiority and practice of the joint tie-layer is then proved by the upward curl at the joint. Yet this new track had the superiority over the carefully got up track upon the running portion of the road, that it did not "see-saw" or eject water from the ends of the ties when run over. Then the question of how greater economy could be obtained, with a useful track for regular trains laid directly from the boarding cars, became a systematic one. "Cannot we so average the skill as to utilize the combined experience and ability of the men more cheaply and with better effect than by relying upon individual and therefore unequal skill?" This question being put was experimented upon and solved to the satisfaction of the Chief Engineer and company in the following manner:

The leading or "surface gang" was stopped entirely, so that the whole work could be carried on from the boarding cars, and under the immediate direction of the track foreman, to whom it was found best to give full charge. The tie-laying party was then divided into two gangs, the first having shovels and earth-picks alone, and under the charge of a competent "boss;" the second, short tie-picks alone, except the joint and center tie-men, who had their measuring pole. All straight-edges and mauls were carefully laid upon the top of the cars, so as to be out of anyone's way. These last were under the tie-bars. Their numbers, of course, varied with the amount of track laid per day, and relatively decreased with gathered experience. This will be shown in the table given in the latter part of this paper. The new mode of work was as follows: The new surface gangs threw up two strings of the black super-soil (where it could be obtained, in preference to clay subsoil, on account of its porous quality caused by its admixture with sand and vegetable humus) about 2½ feet over each side of the center line, and varying from six inches high upon the knolls to 12 or 15 or even more inches in the hollows which age had formed in the banks. This was all the surfacing done, and it was carried on in accordance with the general grade, seeking always to average the settlement and washing of the road-bed. Across these longitudinal ridges ties were drawn by the second gang; the joints measured off, the intermediate correctly placed by eye, the iron dropped forcibly upon it, the iron car and then the train and engine run over it; and this track, though not so pretty as the other at first, lasted much longer in good condition, and was, of course, minus the "see-saw" so long as the ridges were preserved.

After this, upon taking temporary charge of the road, bridges and buildings, when construction was completed, the writer felt a natural desire to try how this mode of track could be made to answer in maintenance. On consultation with experienced track-masters, three faults were found with it. The first was, "that track could not so well be kept in line unless the tie was tamped from end to end;" the second, "that water would get upon the center of the road-bed and be confined there by the ridges;" the third, "that such track could not be 'kept up' without increased labor and expense." The first proved to be entirely imaginary. The "bight" which the ends of the tie get from sinking partially into the ridges, just at the point of easiest displacement, secured the line absolutely well, and relatively much better than when there was a central pivot of hard earth upon which the distorting power acted with a leverage of 2½ feet. The second was obviously true, but it

was better to have the water, with sufficient drains crossing the track, than under the ends of the ties in troughs which could not be drained and were constantly increasing in depth. However, a small shed of earth was placed between the ties, as little as possible being allowed to slide under their middle; and this was only brought in the center to the top of the tie, being from thence sharply cut in a slant to the end. By this means that part of the ridges under the tie was mainly preserved, and a sufficient water-shed added. For the third objection, I can only say that six months' experience wrought a contrary opinion in my own mind. It is true that such *pretty* track could not be maintained. There were none of those "garden spots" which the skillful trackman occasionally takes such pride in, and which on some roads remind us of an oasis in a longitudinal Sahara. But we must remember that these highly wrought spaces require much time, and that while they are being finished to a nicety, other parts of the same division are getting sometimes terribly rough. Large amounts of earth are required, and when the best is used—as it always should is tamped, besides the resulting inequalities from the different skill of different men, the direction be—much time and labor is required in obtaining it, sometimes from a distance. By the arrangement spoken of here, much smaller quantities of earth have to spoken; of the surface, will say this: Where track in which the bar is held packs the earth into a hard wedge or cone directly under the tie, with its base against the tie and its point or edge downward. Now the harder this is in relation to the surrounding earth, the greater is its penetrative power into that earth, and, by consequence, the greater the depression of this superincumbent tie-end under a given force. This should teach us that we should seek as far as possible to pack the earth in horizontal layers and over spaces at least as broad as the tie-end at the top, gradually widening as they descend. I see no way in which this can readily be done with tools; but evidently it can be secured by great weights like that of a driving wheel, and as it is a cheap and speedy process of getting a bearing, I would suggest the enlargement of the idea to trackmen as a good basis for experiment. Of the original plan as applied to track-laying, I can, with more experience, speak with greater certainty, having since tried it with good success. The following tables show the number of men of different grades who wrought, and the cost of one mile of track laid at different rates. The first 110 miles was laid with ties two feet apart. Owing to peculiar circumstances, the second work was done with the ties four feet apart, and intermediate ties afterward "slipped." A table is added showing the cost of some "slipped ties."

By observation of the tables, it will be seen that the cheapest work was done at ¾ mile per day. For this result, however, there were diverse reasons. The weather was better; there was no night running of trains—necessary afterward by lack of flats—making occasional accident and delay unavoidable; the road-bed was in better order. My impression is that one mile per day could be laid under ordinary circumstances at the lowest rate. The roads, too, are different in their teachings. That of 110 miles was kept through a long time, during which the parties' "spare time" was employed at other work, and the record shows the "man-force" requisite for "work done;" while that of 1868, only 25 miles, shows the number of men employed and constantly at the cars, almost every party being daily depleted one or two hands, so that the recorded cost is too great. There are also some apparent and perhaps some real discrepancies, but the intelligent engineer will readily perceive their meaning. In 1868 the track was laid (on account of their scarcity) with ties four feet apart. This track, used for heavy trains, for three months in summer, ran well and was altogether favorable. I have always regretted that it was not kept open longer—or at least a mile of it—so as to show its working in wet weather.

In conclusion, it may not be amiss to make a few remarks upon management.

Track should always be laid so that the transportation

TABLE A.

RECORD OF 110 MILES OF TRACK LAID ON EARTH BALLAST DURING THE YEARS 1857, 1858 AND 1859, AND OF 25 MILES OF SAME LINE IN 1868. FIRST IRON 52 LBS. PER YARD ON CHAIRS; SECOND, 56 LBS. PER YARD, WITH SPLICES.

Six Months.	*Foremen.*		*Bosses.*		*Adzman.*		*Joint Tie-layer.*		*Center Tie-layer.*		*Tielayers.*		*Ironmen.*		*Spikers.*		*Helpers.*		*Total Cost of Labor.*	REMARKS.
	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.		
No. of men per mile of track laid, at the rate of ⅓ mile per day.	2.88	$2 50	8.49	$2 00	2.25	$1 75	2.32	$1 75	2.05	$1 50	23.26	$1 25	12.44	$1 50	20.50	$1 75	4.64	$1 25	$24 60	All the time definitely and upon graduation, of which there was considerable to do, so charged: but all time on tracklaying, and all time lost for want of iron or from accident, charged to track.
Six Months.																				
The same as above, except that the track was laid at the rate of ¾ m. per day.	1.80	2 50	4.7	2 00	1.5	1 75	1.25	1 75	1.5	1 50	12.10	1 25	12.72	1 50	19.21	1 75	4.62	1 25	94 50	Change in form of work; commenced regularly after trial for a month or so back. Length of bar changed in middle of this time from 20 and 22 to 26 feet.
Two Months.																				
Ditto, 1 m. per day	1.75	2 50	6.07	2 00	1.35	1 75	1.30	1 75	1.63	1 50	12.45	1 25	18.05	1 50	25.15	1 75	11.15	1 25	124 15	Weather very bad, roadbed rough, from farmers' teams, and frozen. Much time lost by men paid by the month.
1868.									*Splicers.*											
Ditto, ¾ mile per day	1⅓	3 00	5⅓	2 50	2⅔	3 00	....	.....	8.0	$2 00	15	2 00	13	2 25	20	2 50	10	2 00	170 60	

	Distribution Cross Ties.							Construction Trains.					Iron Cutting and Loading.					Surfacing Roadbed.						
	Bosses.		*Loaders.*		*Teams.*		*Total.*	*Conductors.*		*Brakemen.*		*Total.*	*Bosses.*		*Loaders.*		*Total.*	*Boss.*		*Laborers.*		*Total.*	REMARKS.
	No.	Wages.	No.	Wages.	No.	Wages.		No.	Wages.	No.	Wages.		No.	Wages.	No.	Wages.		No.	Wages.	No.	Wages.		
½ mile per day.	2.85	$2 00	16.69	$1 25	13.71	$3 00	$67 60	2.10	$2 50	6.57	$1 25	$13 46	3.25	$1 66	21.50	$1 10	$29 06	1	$2 00	10	$1 25	$14 50	Brakemen unloaded cattle-guards, etc.
¾ mile per day.	1.9	2 00	15.65	1 25	13.41	.....	63 60	4.40	.....	10.03	.....	23 52	Iron cutting transferred to transportation department.					1	2 00	9	1 25	13 25	Two trains; one for ties alone.
1 mile per day..	2.0	2 00	19.12	1 25	22.42	3 00	95 20	6.75	.....	12.47	.....	32 46	Ground rough and frozen for distribution.					1	2 00	9	1 25	13 25	Trains ran night and day, with three sets men.
1868.																							
¾ mile per day.	2	2 50	9.75	2 00	14.8	4 00	83 70	Engine and train expenses.				33 00	....	.....	..	.....	..	1	2 50	8	2 00	18 50	

1868.	Slipping Ties in Half-tied Track.									Generalization, 1868.				
	Bossing.		*Loading and Distributing.*		*Tielayers.*		*Spikers.*		*Engine expenses.*	*Total.*		Cost of Track.	Distrib. Ties.	Train Expense.	Surfacing.	Cost of labor in all.
	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.								
Cost per mile	3.2	$2 50	16.66	$2 00	19.6	$2 00	9.8	$2 50	$43 63	$147 66	Cost track, 1868, in good order	$170 60	$83 70	$33 00	$18 50	$305 80
											Some parts filled in, others not, so that the maintenance cost is left out.					

be moved. The track is lifted a joint or so at a time, the ridge of earth thrown in under the rail, the proper quantity and height is soon correctly acquired, the track dropped upon it, the first train passed with "caution," a small amount of earth is then thrown only between the ties, sloped off properly, and the job is complete.

It seems to me better to scoop out earth from beneath the middle of the tie than to put any in. Supposing that my reasonings are right, the question would be whether it is better to get up short pieces of track, trying to make them last, or whether it is better to use the same amount of labor in a more expeditious way, and thereby be enabled to go over the whole division oftener. While inclined to believe the latter, I am not disposed to assert my short experience in track maintenance against those who have spent years at it. With me the plan was a relative success. What it would be to others I shall not seek to determine. The result was this: that we succeeded in keeping up each division or section in fine order without super-excellent places and without rough ones, and at moderate cost. Further, it appeared to me that the endurance of track got up in this way was greater than that of "tamped" track. The result may not be entirely correct, yet there seems to be good reasons for it theoretically. Of the line, I have already

GENERALIZATION OF TABLE "A" ('57 TO '59).

			Per Mile.
Track-laying in full (for '57, '58 and '59).	$13,184 29		
Use of boarding cars (1868 not inclusive)	25 00		
Loss on board	250 00		
Wear and tear of tools	50 00		
Bedding and furniture	175 00		
Hauling water	250 00		
		$14,159 29—	$128 72
Distribution of ties	$7,289 51		
Additions proportioned on above	800 00		
		8,089 51—	83 40
Surfacing road-bed, with additions			15 00
			$227 12
Repairs and maintenance, including the filling up of track-laying (one-half charged to track)	$14,865 68		
With additions as above	680 00		
		15,545 68—	80 96
Cost of track in good order			$308 08

DEDUCTIONS.

	Number.	Cost each. Cents.
One man lays intermediate ties	126	1
" " " joint ties	125	1.75
" " drives spikes	758	.298
" " lays bars of iron	31.5	4.76
" " loads ties on wagon	149	.84
" team hauls of ties	169	1.77

The distribution of ties and maintenance was required for something less than 100 miles. The track was all in first-class condition, except the last six or seven miles, which, being near a town, was so cut up when soft by wagons and then frozen, that this was impossible with it.

department may accept each 25 miles newly from the engineer. This brings your supplies depot at a convenient distance. This allows you to use your engine or engines with economy; for by starting from the boarding-train after an early breakfast, the locomotive may get to the supply depot, do all its switching, and get back at a time varying from 11 to 2 o'clock; move your train to the end of track (if your gangs are well arranged they will have the last truck of iron run out by this time), have the iron ties, etc., thrown off, back the train and be in a condition for cleaning or slight repair. It will then be in condition for the morrow's work. Do not allow her to be "see-sawed" by yourself or others. I have frequently known an engine spend her time running up and down after bolts and other small matters which, with attention, could just as easily be brought on the regular trip.

If your gangs, being properly proportioned to the work, can by extra exertion get through the full day's work a little early, let them have the time. It will teach them to work fast and earnestly, so that when you are in a push you can call upon them for greater exertion; and when it is necessary to add new men, these will soon be forced by the old ones (who have been trained, or, better, who have, for the sake of the extra time, trained them-

selves to work fast) to do their full share. Thus, by interspersing new men at any time you may keep up to any requirements for greater speed received from the company, and at the same time improve your men by the time given and by raising their ambition.

Get the best men, for which purpose you must pay fairly; have comfortable beds and food, both the latter as clean and desirable as possible, by which means, and by speaking to and having them spoken to civilly, you make a discharge a punishment instead of a pleasure or matter of indifference. Then you can keep each man in his best place, and thereby obtain *much greater work with the same labor.* The little that you lose on board becomes as nothing when returned by willing service. Let no liquor come into the cars; as far as possible encourage the men in sobriety and good conduct, and let your only punishment be a civil discharge.

LOUIS NICKERSON, Civil Engineer.

THE INVENTION OF LOCOMOTIVE TRUCKS.

ROME, N. Y., December 13, 1871.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your issue of 9th inst., page 376, you criticise Brown's "History of Locomotives." As my name is introduced, I hope you will allow me space for explanation.

In the discussion of any matter, it is important to understand clearly what the subject is. You state "that the truck, or, as our English friends call it, the bogie, was designed and applied to locomotives by Mr. Allen nearly a year before Mr. Jervis used it." The question is, What kind of a truck did Mr. Allen use? and what kind did Mr. Jervis use?

In the summer of 1830, Mr. Horatio Allen was the Chief Engineer of the South Carolina Railroad, and I was Chief Engineer of the Mohawk & Hudson, now a portion of the New York Central Railroad. Mr. A. was allowed to spend his summers in the North. He occupied this privilege by spending nearly his whole vacation with me at Albany, as he also did the following summer. We were both very much interested to ascertain some method by which the weight of an engine could be spread on more wheels, work more favorably, and thus save our weak railroads from an action they could not safely support. On these occasions, Mr. A. and myself fully discussed all plans that suggested themselves to us to secure this object.

We both knew very well that two cars or wagons had been connected by a general frame, with transom and center-piece, and used for heavy weights and long timber. That these had been used at moderate speed we well knew. We also knew that an eight-wheeled locomotive had been constructed resting on two four-wheel frames, so arranged as to rest on these two, and that each acted in its lateral motion independent of the other. This engine had four cylinders, two resting on one frame and two on the other—all receiving their steam from the one boiler, resting on the upper or main frame. I had a plan of this engine, but in some way the book is lost. Reference to it is made in Wood's last work on railways, page 136, American edition. This engine was too complicated, and failed to be useful.

The question with Mr. A. and myself was not, Could two separate cars or trucks be so connected as to run on a railroad? but, Could this be done in a way that would secure the requisite speed for passengers? To this we addressed ourselves, and with the utmost frankness, as I believe. In our many discussions on this subject, it was clear that we had different ways of reaching the object. As I have said, it was known that two four-wheeled cars had been so coupled as to carry freight and, in one instance, a locomotive. But the general impression was, that the arrangement would not admit of proper speed with safety. At the time I speak of—1830, 1831—I knew of no engineer of much standing, except Mr. A., that supported or approved of my truck. Even Mr. Allen objected to it, as only a half-way measure, and frequently urged me to take his views. He was then preparing his plan at Albany. Mr. A.'s plan was simply putting two engines together, and coupling them by transom and pin, on which his own boiler rested. He had one pair of driving and one pair of small wheels under each engine. I was content to have a simple truck, all wheels alike, as a support, guide, and to give more steady motion. Would such an engine keep the track or rail at high speed? This was the question. The English called it "bogie," or scare-crow. The Eastern railroads would not use it, and up to 1836 most of their engines were four-wheeled, English made or on English pattern.

You say Mr. Allen put his engine in motion one year before mine was put on. His was on about six months before mine. But this is immaterial, as all the ideas and plans were discussed together, and they were not the same in plan or result. Mr. A. took his course and I took mine, which was a different one. His was properly a double engine with a single boiler, connecting the two frames on which each engine rested separately. Mine was simply and properly a truck placed under the front end of the engine as a support, guide, etc. All the machinery of the engine was placed on the main frame, resting on the driving-wheels at one end, on my truck at the other end. This is what I claim *in idea and invention.* The fact that we took different methods is obvious from the respective practical workings.

I have shown that neither Mr. Allen nor myself is entitled to the credit of originating the truck principle, or that principle by which two cars or trucks may be connected by a common frame and made one machine, either in cars or locomotives. All we are entitled to is our respective plans for adapting this principle to passenger speed, which had not previously been done.

It is now say forty years since these two plans were put on trial. I do not know that Mr. A.'s locomotive is used on any railway. Mine may be seen on 50,000 miles of railway, substantially the same as put in motion in 1832. You admit there was a difference in the two, and that my application has come into general use. I can hardly ask for more important admission. The fact is, Mr. A.'s engine has never been duplicated to my knowledge. My plan is in general use.

You seem of the opinion Mr. Fairlie (of England) may yet make something out of Mr. A.'s plan. Perhaps he may. If I understand Mr. Fairlie's method, he makes all his wheels alike, and all drivers. Now, it is clear what Mr. Fairlie has to do is, to devise a satisfactory connection between his boiler, resting on two cars, or frames combined, and his cylinders, that rest each pair on a separate frame, having motions out of parallel. It is reported that Mr. Fairlie has succeeded in this. If so, he has accomplished what I believe had not been done before. It is clear that Mr. F. had based his experiments on my plan of truck, having first used it as merely a supporting element. The eight-wheel cars have the same origin.

Not liking to trespass on your space, I have made my explanation as brief as appeared practicable.

I can bear testimony to Mr. Brown's indefatigable zeal and industry in collecting materials for a history that will be read with much interest. To look at the locomotive as registered by Mr. Brown, and then at the present condition, it is seen that a vast progress has been made, verifying the early prediction of the *Westminster Review*, "That the railway was an epoch in the affairs of mankind."

JOHN B. JERVIS.

NOTES ON THE MANAGEMENT AND DISCIPLINE OF AMERICAN RAILROADS.

BY A HINDOO.

[CONTINUED FROM PAGE 375.]

The careless handling of baggage is a matter demanding serious attention. A certain amount of roughness may be inseparable from celerity and dispatch; but, as a railway traveler may daily see, there is also an abundance of roughness without the celerity. It is not by any means necessary, or even desirable, to secure extra dispatch at the expense of the baggage. The golden mean can be found in this as in all other conditions, and the traveling public are entitled to more consideration in this respect than they now receive.

The newsboys—I beg their pardon, the *news agents*—are, on the whole, a nuisance. To be able to buy a book, a paper or a cigar, when the idea enters one's head, is well enough; but to have books you don't want, or obscene advertisements and publications thrown into your lap, often when you are already reading; to be jostled, to receive impertinence on refusal to buy, to be awoke from your nap—all these little things are unpleasant. The evil is not balanced by good. Travelers can always lay in at stations sufficient supplies of reading and edible matter. The car-boy, however necessary in theory, is in practice appreciated by only the lowest class of passengers.

The system of checking baggage by duplicate brass tickets—one given to the passenger, the other attached to the trunk or box—is convenient for baggagemen and admits of quick dispatch, but has many disadvantges.

1st. Checks are occasionally mismatched, rendering a piece of baggage liable to be sent several hundred miles from its proper destination.

2d. The strap-check is easily broken off and lost or removed by designing persons. It frequently happens that a baggageman, having overcarried a piece, rather than acknowledge the error removes the check and thus shifts the blame from his shoulders.

3d. When by accident or otherwise the strap-check has become detached, there is no means of recognizing the piece in the absence of the owner.

4th. Many pieces of baggage have no handle or other means of attaching the strap-check.

Between large cities the checks show the sending and receiving stations, but for way-baggage the check shows only a number. The receiving station is indicated by a number chalked on the package. The evils of this arrangement are apparent and serious.

1st. The chalked number can be altered at will by train baggagemen or anybody else, or may be obliterated by friction against other packages.

2d. The station baggageman may in error chalk a wrong number, and so send the package to a station other than the one it should go to.

3d. A passenger having his trunk checked to one station, say No. 6, may afterward travel to No. 12, perhaps by another route; and, on arriving there, presenting his check, demand his trunk, and then pretend to be indignant on being told that it is at No. 6. This may appear improbable and absurd, yet I know such cases do occur, although not frequently. Indeed, I am certain that many pieces of baggage are checked and carried free by railroad companies for persons who do not travel, but prefer sending their packages free to paying express charges.

4th. When a piece of baggage is put off at the station it is chalked for, if a mistake has been made the receiving station cannot detect it, and there is no mark to indicate the sending station.

5th. Many packages, such as bundles, skin-covered trunks, etc., cannot be marked with chalk; there is then nothing to guide the train baggageman.

A better plan of baggage-checking is the label system. Each station is supplied with printed labels of this form:

1256	1256
ATLANTIC & PACIFIC RY. AURORA TO ALBANY.	ATLANTIC & PACIFIC RY. AURORA TO ALBANY.

These labels are kept sorted in a movable tray or stand. The left-hand portion is torn off and given to the passenger, the other part being pasted on the package. The traveler sees at once whether his luggage is ticketed rightly or not.

This system meets every one of the objections above enumerated. It has the further advantage that it avoids the trouble of returning checks to the place of issue, and there is no chance of the supply failing. Its only drawback is that a package after several trips might become covered with old labels, so that it would be impossible to know which is the right one. A little care would prevent this. Old labels should be defaced before putting on a new one, or the new one should be pasted over the old. These labels should always be placed on the end of the package, not on the side or top. When placed on the end it is more easily seen and is not so liable to be defaced by friction.

The system of brass checks now in use does very well for large cities and for long distances; but for way-bagg ge nothing can equal the label plan. Station daily reports should show the labels issued, just as is shown in ticket reports, and the head office should see that all counterparts are returned from receiving stations and destroyed.

A great convenience to travelers is the depot check system obtaining at some stations. Unfortunately few roads in this country have it in operation.

[TO BE CONTINUED.]

Experiments on Boiler Explosions.

The following is the official report made under date of December 12, 1871, to the Secretary of the Navy by B. F. Isherwood, E. S. De Luce and Sidney Albert, Chief Engineers United States Navy:

SIR: Agreeably to your orders of the 18th ultimo, appointing the undersigned a Board to witness, report upon and give all necessary information relating to the experiments being made at Sandy Hook, New York, by Mr. Francis B. Stevens, of Hoboken, New Jersey, on steam-boiler explosions, we have the honor to submit a description of them as far as they have progressed, accompanied by our observations on their results.

The experiments referred to were devised by Mr. Stevens, in pursuance of the following resolutions, passed on the 11th of September last, by the Executive Committee of the United Railroad Companies of New Jersey, namely:

"That in order to attain greater safety in the steam-boilers belonging to the United Companies, Mr. F. B. Stevens be authorized to continue the experiments on the strength and proper management of such boilers; and for this purpose to expend not exceeding ten thousand dollars, the vouchers for which to take the ordinary course.

"That other owners of steam-boilers are hereby invited to contribute to the experiments to be made by Mr. Stevens; and that the wharf, shops, derrick and tools belonging to the United Companies, at Hoboken, may be used for this purpose, at cost prices, and a copy of the charges given by the Auditor to the contributors.

"That Mr. Stevens be advised to invite the United States Inspectors and other prominent engineers to be present at the experiments."

On the 20th of September last Mr. Stevens received permission from the Secretary of War, at the instance of the President, to make the experiments on the Government reservation at Sandy Hook; and to that place he transported the experimental boilers, with the necessary instruments, material and shed accommodation.

The boilers to be experimented with were nine in number; they were conveniently arranged on a well-chosen piece of ground inclosed by a high board-fence, and were provided with the requisite pressure and water gauges. The former were expressly manufactured for the occasion, and had been carefully tested. Five pressure-gauges were placed near each

boiler tried, under the protection of 2 bomb-proof; and two, tested to a pressure of 500 pounds per square inch, were placed side by side, at a safe distance from the boilers (about 250 feet on the first day and 450 feet on the second day of the experiments) with which they communicated by a pipe of suitable length; while in this position their indications were compared with those of the tested pressure-gauges at the boilers, and found to agree. All of Mr. Stevens' arrangements were judiciously made, and nothing was wanting to their accuracy and completeness.

EXPERIMENTS OF THE 22D OF NOVEMBER, 1871.

On the 22d ultimo, in accordance with a notification from Mr. Stevens, we proceeded to Sandy Hook, and witnessed the first experiments in company with the following gentlemen who are largely interested, practically and scientifically, in the design, construction and use of steam-boilers:

Joseph Belknap, Inspector General of Boilers; H. Birdsall, Inspector of Boilers; R. B. Davenport, Reporter for the New York *Herald*; J. B. Collin, Mechanical Engineer of the Pennsylvania Central Railroad; Coleman Sellers, President of the Franklin Institute, Philadelphia; Dr. Wm. H. Wahl, Jr., Secretary of the Franklin Institute, Philadelphia; Professor Jacob Naylor, of Philadelphia; Wm. N. Henderson, of Philadelphia, Mechanical Engineer; E. H. Shallcross, of the Select Council of Philadelphia; Wm. Fisher Mitchell, of Philadelphia; Thomas J. Lovegrove, of Philadelphia; R. H. Thurston, Professor Mechanical Engineering, Stevens' Institute, Hoboken; A. Fletcher, W. Fletcher, builders of steam engines and boilers at New York; C. H. Haswell, examiner of steam machinery for the New York insurance companies; Norman Wiard, John McCurdy, James Miller, Messrs. Phinney & Hoffman, David Saunders, of the firm of J. Nason & Co., New York; Erastus W. Smith, mechanical engineer; W. E. Worthen, mechanical engineer; Robert Allen, Ralph Walker, G. H. Clemens, John Stuart, C. M. Bolen, T. S. Crane, John Dunham, Andrew Fife, John Fish, John McGowan.

The first experiment was made on a boiler built by Fletcher, Harrison & Co., in 1858, and taken out of the steamboat Joseph Belknap in July last, after having been thirteen years in use. It is of the ordinary upper-return flue type, with a rectangular front 7 feet 8 inches long, 6 feet 6 inches wide, and 6 feet 11 inches high, containing two furnaces, each of which was 2 feet 9 inches wide and 7 feet long; the top of this front is semi-circular and single riveted. The remainder of the shell is a cylinder of 6 feet 6 inches diameter and 20 feet 4 inches length, unbraced, single riveted, and with a flat end. The total length of the boiler is 28 feet. The iron of which the shell is composed is a large ¼ inch thick, and all the flat surfaces are braced every 7 inches. The top of the furnaces is flat and braced to a semi-circular top of the shell immediately over it; and from this semi-circular top there rises the usual cylindrical "steam chimney" or annular steam-drum surrounding the lower portion of the chimney and braced to it. The steam-chimney is 4 feet in external diameter, 2 feet 8 inches in internal diameter, and 10 feet 5 inches in height above the shell. The lower flues are ten in number and 15 feet 9 inches long; two of them are 16 inches in inner diameter, and the remainder are 9 inches in inner diameter. The upper flues are twelve in number, 22 feet long, and 8½ inches in inner diameter. The least water-space between the flues is 2¾ inches in the clear. All the flat water-spaces of the boiler are 4 inches wide, including thicknesses of metal. The grate surface is 38½ square feet. The water-heating surface in the furnaces is 80.09 square feet; in the combustion chambers, 31.84 square feet; in the lower flues, 428.70 square feet; in the back connection, 76.92 square feet; in the upper flues, 587.48 square feet; and in the front connection, 57.98 square feet; making a total water-heating surface in the boiler of 1,263 square feet. The steam-superheating surface in the steam-chimney is 84 square feet.

This boiler, on the 2d of September last, was subjected, at Hoboken, to a hydrostatic pressure of 112 pounds per square inch, which broke a few of the braces without altering the form of the semi-circular top of the rectangular front. After being repaired it was again subjected, at Sandy Hook, on the 4th of November last, to a hydrostatic test of 82 pounds per square inch, without the rupture of any part; and on the following 15th of November it was subjected to a steam pressure of 60 pounds per square inch, without fracture.

In the experiment of the 22d of November, which we witnessed, the fuel used was wood, and it was intended to burst the boiler by steam-pressure under the condition of 12 inches of water above the top of the flues, but it was found that the pressure could not be raised above 93 pounds per square inch, owing to the excessive leakage of steam from the seam joining the steam-chimney to the boiler-shell. At the above pressure no fracture occurred, but the form of the semi-circular top of the rectangular front underwent a change. The experiment was only of value in showing the strength of a boiler of this type and construction after thirteen years service in a vessel.

The next experiment was made on a rectangular box, built to represent the flat water-space or water-leg of the Westfield's boiler, recently exploded at New York on board that vessel, with great destruction of property and life.

This box was 6 feet long, 4 feet high, and 4 inches wide, over all. The two side-plates were of the best flange fire-box iron 5-16th of an inch thick, manufactured by the Abbott Iron Company. The plates were held together by a single row of rivets at their edges, passing through a frame made of wrought-iron bars, mitred at their ends, and having the same outside dimensions as the box. These bars were 3¾ inches wide, 2 inches deep, and perforated at the center line by the holes for the rivets. The side-plates were braced together every 8¾ inches one way and 9½ inches the other way of their surface by bolts of 1¼ inch diameter, with threads cut upon each end and screwed into corresponding threads cut in the plates, over which both ends of the bolts were slightly—and but very slightly—riveted. The box was placed on one edge upon an 8 inches thick brick-wall, and was inclosed with side-walls of brick masonry, with the exception of a strip 15 inches deep at the top and 12 inches wide at one side, which protruded into the air, and to which the gauges were attached. The inclosed portion of the box was heated by two small furnaces without intercommunication, the fire-grates of each being 27 inches long and 14 inches wide. The fuel was wood, and the products of combustion were discharged through two sheet-iron pipes. The surface of the box exposed to the fire was 19½ square feet, and was all water-heating surface, as the box was filled with water to within 9 inches of its top. Of the total interior height of the boiler, therefore, 37 inches were occupied by water and 7 inches by steam.

When the pressure reached 165 pounds to the square inch the box exploded with a loud report, completely demolishing the brick-work by which it was inclosed. The two sides were hurled in exactly opposite directions, and to about equal distances, at right angles to their surfaces. The fracture had occurred in one plate only, and was along the whole riveted seam joining it to the frame. For a large part of the length of the seam this plate was torn out between the rivets, and for the remaining part the rivets were sheared. The other plate was not fractured, nor were the bars of the frame broken; the plate and the frame remained riveted together, but not uninjured—all the bars of the latter being bent considerably inwards, forming an irregular curve of from four to six inches versed-sine. Both plates were bulged out irregularly, so as to be about nine inches dishing, and the bulging took place near the bars. Not one of the bolts was broken, and neither the threads upon their ends, nor the threads in the plate, were stripped or injured, but the slight riveting over of the ends of the bolts was broken off in all of them.

The fires being brought to steady action, and steam raised to the atmospheric pressure, the opening for the escape of the latter was closed, and the pressure rose as follows, for the corresponding times, namely:

TIME P.M. Hours	Minutes	Steam-pressure in pounds per sqr. inch above the atmosphere	TIME P.M. Hours	Minutes	Steam-pressure in pounds per sqr. inch above the atmosphere
3	18	0	3	36	51
3	20	4	3	37	54
3	21	5	3	38	58
3	22	7	3	39	65
3	23	9	3	40	72
3	24	11	3	41	78
3	25	13	3	42	86
3	26	15	3	43	94
3	27	18	3	44	100
3	28	20	3	45	110
3	29	23	3	46	117
3	30	27	3	47	126
3	31	30	3	48	135
3	32	34	3	49	147
3	33	38	3	50	160
3	34	44	3	51	165
3	35	49			

The fact that the plates did not rupture at the center under their great amount of bulging (and only one of them tearing off at the line of rivets along its edge) shows the excellence of the metal which endured this great, almost instantaneous, and permanent stretching without fracture; and to this same extensive stretching must be attributed the escape of the screw threads on the ends of the bolts, and in the plates, from injury. The plate, by stretching, simply enlarged the diameter of the hole in which the threads were cut, until the bolt, thus left free, slipped through without injury to its threads, only breaking off the slight riveting over of its ends. Had these bolts been secured by nuts on the outside of the plates, the box would have borne an enormously greater pressure than that which exploded it. Between the bolts there was a small permanent stretching of the plates, giving each space between the bolts a slightly dishing or bulged form, in addition to the general bulging of the plates, thus forming a system of secondary bulges, as it were; and around every bolt both plates were strongly marked by a congeries of circular crispations.

The conclusions from this experiment are: That a gradually accumulating steam-pressure in a boiler can produce a true explosion, violently hurling its fragments, with a loud report, to a considerable distance, even though 84 per centum of its capacity be filled with water; and that screw bolts should not be used in boiler-construction without nuts, or having, as an equivalent, a large portion of their ends formed into massive rivet-heads; because the stretch of the plates is sufficiently great, under a much less pressure than will fracture the bolts or strip their threads, to allow the latter to slip through uninjured.

Previous to this experiment the box had been subjected, at Sandy Hook, to a hydrostatic pressure of 138 pounds per square inch, and to a steam pressure of 102 pounds per square inch, without fracture.

EXPERIMENT OF THE 23D OF NOVEMBER, 1871.

On the 23d ultimo, a last experiment was made by exploding a boiler in the presence of the undersigned, and the following gentlemen, namely:

Captain W. W. Woolsey, Superintendent of the Jersey City Ferry.

William and Andrew Fletcher, of the firm of Fletcher, Harrison & Co., engine and boiler makers.

Anning Smith, Superintendent of the North-Shore Ferry Company.

J. B. Collin, Mechanical Engineer of the Pennsylvania Central Railroad.

William A. Dripps.

Thomas Lingle and Wm. Brown, of the Camden & Amboy Railroad.

The boiler that was exploded during this experiment was built by T. F. Secor in 1845, and taken out of the steamboat Bordentown, in August last, after having been 25 years in use. When taken out, the inspector's certificate allowed it to be worked with a pressure of 30 pounds per square inch. It was a horizontal fire-tube boiler, with the tubes returned immediately above the furnace and combustion chamber.

It had but one furnace, and that was 11 feet 5 inches in width, with grate bars 7 feet in length. The top of the furnace and the top of the combustion chamber were flat, and braced to the flat top of the shell above them by rectangular braces 2 inches by ½ inch in cross section, placed 17 inches apart crosswise the boiler, and 12 inches apart lengthwise the boiler, each brace holding a flat surface of 204 square inches, to which it was attached by crow-feet so arranged that the flat surface between the sustaining rivets was 12 inches square. The flat water-spaces were braced at intervals of 8 inches in one direction and 12 inches in the other, by 1 inch diameter screw-bolts, each of which held a flat surface of 96 square inches. The iron plates of the boiler were a large ¼ inch thick.

The tubes were of iron, and 384 in number, arranged in 8 rows vertically and 48 rows horizontally. Each tube was 2 inches in outside diameter and 12 feet in extreme length. The total height occupied by the tubes from the lower side of the lower tube to the upper side of the upper tube was 22 inches. The tubes were divided into sixteen groups, and the groups were separated by water-spaces 2 1-16 inches wide in the clear vertically, and 1¾ inch wide in the clear horizontally. From the lower side of the lower row of tubes to the top of the furnace and combustion chamber was a space of 6 inches in width for water-circulation. The bridge-wall and the bottom of the combustion chamber were of brick. The furnace had no water-bottom, but its side legs of 4½ inches width rested in a pan which covered the entire area beneath the surface.

The shell of the boiler was rectangular with the exception that the vertical sides were joined to the flat top by quadrantal arcs of 37 inches radius. All the seams were single riveted.

Upon the center of the top of the boiler was a cylindrical steam-drum of 6 feet diameter and 8 feet 8 inches height.

The flat water-space at the front of the furnace was 4½ inches wide, and that at the back end of the boiler was 5 inches wide, including thicknesses of metal.

The width of the boiler was 12 feet two inches, its length was 15 feet 5 inches, and its height, exclusive of the steam-drum, was 8 feet 6 inches.

The following were the grate and water heating surfaces of the boiler:

Grate surface	79 11-12	square feet.
Heating surface in furnace	180	" "
" " in combustion-chamber and back connection	103	" "
" " in tubes	2171	" "
" " in up-take	64	" "
Total heating surface	2518	" "

The shell was braced very unequally. Each upper horizontal brace, 1¼ inch large in diameter, sustained the pressure upon a surface 28 by 12 inches, or 336 square inches; and each rectangular vertical brace adjacent the sides, 2 inches by ½ inch in cross section, sustained the pressure upon a surface 19 by 12 inches, or 228 square inches; these were the weakest places.

On the 2d of September last this boiler was subjected to a hydrostatic pressure of 60 pounds per square inch, when twelve crow-feet gave way. After being repaired, it was again subjected on the 6th of November last, when erected at Sandy Hook, to a hydrostatic pressure of 59 pounds per square inch, which it bore without fracture; and on the 16th of November last it was subjected to a steam-pressure of 45 pounds per square inch, which it also sustained without fracture.

The fuel used in the experiment was wood, and the water-level in the boiler was 15 inches above the highest point of the tubes. When the fire had been brought to steady action, the pressure of the steam gradually increased at the following rate, commencing with the pressure of 29½ pounds per square inch.

TIME P.M. Hours	Minutes	Steam-pressure in pounds per sqr. inch above the atmosphere	TIME P.M. Hours	Minutes	Steam-pressure in pounds per sqr. inch above the atmosphere
12	21	29½	12	30	46½
12	23	33½	12	31	48½
12	25	37½	12	32	50
12	27	41	12	33	52
12	29	44½	12	34	53½

At the pressure of 50 pounds per square inch, some of the braces of the boiler gave way with a loud report, and when the pressure of 53½ pounds was reached, the boiler exploded with terrific violence. The steam-drum and a portion of the shell attached to it, forming a mass of about three tons weight, were hurled to a great height in the air and fell to the earth at about 450 feet from the original position of the boiler, crushing several trees in their fall. Two other large fragments fell at less distances, while smaller ones were thrown much farther. Almost the whole of the boiler was literally torn into shreds, which were scattered far and wide, the only portion remaining where the boiler had been being the tubes. These, though considerably distorted, were otherwise uninjured. Both tube-plates had been blown from the tubes in opposite directions, and at the same moment, for nearly all the tubes were found lying in a heap on the ground immediately beneath the place they had occupied in the boiler, the riveting of their ends over the plates having been simultaneously stripped. The top of the furnace and the top of the combustion chamber, which, in the boiler, were immediately beneath the tubes, had entirely disappeared into debris, as had also the sides and ends of the shell. The boiler seems to have first yielded by the fracture of the upper row of horizontal braces. The loud report heard when the pressure attained 50 pounds per square inch was probably caused by their breaking. The larger masses were all thrown in one direction—at right angles to the side of the boiler; but the smaller fragments were projected radially in all directions, as from a center. Two heavy bomb-proofs, constructed of large timbers and sand, for the protection of the other boilers, were dislodged, and a part of the fence of the inclosure was destroyed by the impact of the flying fragments. The crow-feet, in most cases, remained firmly attached to the shell, and the braces had parted—probably in the welds—leaving the ends still secured to the crow-feet. The screw-bolts which braced the flat water-spaces had slipped from their fastenings in the plate without injury to the screw-threads either upon them or in the plate. The latter was permanently bulged or dished between the bolts, and this stretching of the metal had, by its enlargement of the holes, allowed the screw ends of the bolts to draw out without injury to the threads, either on the bolts or in the plates.

The ground beneath and for a considerable distance around where the boiler stood was saturated with the water of the boiler, in fact made into mud, and the adjacent grass and small shrubbery were so drenched that an ordinary boot was wet through by walking among them. At seven minutes before the explosion took place, the water-gauge on the boiler was examined and found to indicate the water level 15 inches above the top of the tubes.

The conclusions to be drawn from this experiment are the following:

1st. An old boiler, containing a large mass of water above the highest point of its heating surface, can be exploded with such complete destruction as to reduce it into mere debris and hurl the fragments in all directions with a force that no ordinary construction of building or vessel could withstand.

2d. That the pressure required for so devastating an explosion is the very moderate one of 53½ pounds per square inch.

3d. That with only a wood fire, generating a far less quantity of heat in equal time than a coal fire, there were required only thirteen minutes to raise the pressure from the Inspector's working allowance of 30 pounds per square inch to the exploding pressure of 53½ pounds per square inch, showing that a few minutes' absence or neglect of the engineer, coupled with an overloaded or inoperative safety-valve, are all that are needed to produce the most destructive steam-boiler explosion, even with an old and unequally braced boiler, in which it might be supposed a rupture of the weakest part would precede other fracture, and allow the escape of the pressure without doing further injury.

4th. That in accounting for either the fact of an explosion, or for its destructive effects, there is no necessity for hypotheses of low water, enormous pressures, instantaneous generations of immense quantities of steam, superheated steam, the formation of hypothetical gases, development of electricity, etc., etc. The most frightful catastrophe can be produced by simply gradually accumulating the pressure of saturated steam to a strain at which the strength of the boiler yields, nor need that pressure be much above what is ordinarily employed with boilers of this type.

5th. That there is no flashing of the boiler-water into steam at the moment of an explosion. On the contrary, with the exception of the small portion of this water vaporized (after the reduction of the pressure owing to the rupture of the boiler) by the contained heat in it between that due to the temperature of the steams of the exploding pressure and of the atmospheric pressure, it remains unchanged, and is thrown around, drenching the objects near it, and scalding whomever it falls upon.

6th. The weakest portion of the boiler braces was in their welds.

7th. The equal stretching in all directions of the boiler-plates between the screw-bolts, due to their bulging under the pressure, was sufficient to permit the slipping out of the bolts without injury to the screw-threads either upon them or in the plates.

8th. That this experiment has conclusively disposed of several theories of steam-boiler explosion, replacing vague conjecture and crude hypotheses with exact experimental facts, and, by thus narrowing the field for the search of truth, has made its discovery more probable.

All of which, together with drawings of the boilers experimented with, are respectfully submitted.

RAILROAD GAZETTE

Published Every Saturday.

A. N. KELLOGG, *Proprietor.*

S. WRIGHT DUNNING AND M. N. FORNEY, *Editors.*

W. H. BOARDMAN, *Acting Publisher.*

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Editorial Announcements.

Address.—The RAILROAD GAZETTE *will be printed for the present in New York; our printing house in Chicago having been destroyed. All communications, therefore, whether editorial or business, should be directed to the New York office. The proprietor will receive subscriptions and advertisements at his office in Chicago, Nos. 63 and 65 South Canal street, but letters should be addressed to New York.*

Correspondence.—We cordially invite the co-operation of the rail road public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Inventions.—No charge is made for publishing descriptions of what we consider important and interesting improvements in railroad machinery, rolling stock, etc.; but when engravings are necessary the inventor must supply them.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay. EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

THE ST. LOUIS & SOUTHEASTERN RAILWAY.

This company, which is comparatively a new one, has been managed with such energy and success by its officers, who have distinguished themselves for ability both in administration and engineering in war and peace, that it now has 202 miles of railroad in full operation, embracing a short line from St. Louis across Southern Illinois to Evansville, near the southeast corner of Indiana, and a branch to Shawneetown, Ill., on the Ohio a short distance below the mouth of the Wabash River.

The territory which it crosses is somewhat varied in character, most of it being prairie, but a large proportion (for Illinois) heavily wooded; while on the western part of the line are productive coal mines, already pretty well worked, but capable of much greater production, and for which there is an almost unlimited demand. On the southwest terminus, near Shawneetown, there are mines of a peculiar coal, said to be unusually valuable for iron smelting; and also lead mines and salt works, which are in operation, and are likely to supply a considerable traffic. It is somewhat remarkable that, while the road is quite direct, it passes through the county seats of all the counties on its line. Very few of these are large towns, but they are the largest places in that part of the State, and likely to grow with the growth of the country around them, which, though settled longer than any other part of the State of Illinois, is much less developed and improved than the country north of it. About 50 miles of the line, from St. Louis eastward, should be excepted. It is already well settled and well improved, with thriving mining industries as well as agriculture, and the beginning of manufacturing interests which promise soon to become of great importance and make large demands upon this and the other railroads diverging from St. Louis and East St. Louis. Already there are smelting works and rolling-mills in East St. Louis, and an eminent German authority on metallurgy has recently expressed his opinion, after a critical examination of different iron-producing places in America, that there iron may be smelted more profitably than anywhere else in this country. There, too, will be construction and repair shops of the numerous railroads which converge there—now no less than eight. Belleville is already a large and prosperous town.

The progress of coal mining on this road may be inferred from the fact that within the past year fifteen coal shafts have been sunk along the line, are now worked, and supply 400 to 500 tons of freight for shipment daily. These mines are all within 23 miles of St. Louis.

The country on the line of this road has heretofore bought and sold chiefly in St. Louis, Evansville, Louisville and Cincinnati. The railroad improves its connections with all these cities. It gives direct connections to St. Louis and Evansville, of course, and, in connection with the Ohio River, with the other cities, with which, however, it will soon have railroad connections. This part of Illinois has not dealt much with Chicago heretofore, but, in connection with the Illinois Central, the Chicago & Alton, and the newly completed line from Chicago to Evansville, the new road will be able to do a Chicago business for most points on its line better than can be done otherwise.

The company's best prospects for through business are as a section of a short line between St. Louis and the Southeast, including all points on the Evansville, Henderson & Nashville Railroad, Nashville and the railroads extending thence southward and eastward, and the connections of the latter lines, including most of the lines in Alabama, Georgia, Florida and the Carolinas. To all these the new railroad forms a short route, shorter than any other existing, and to much of the country as short as any likely to be made. The business between these districts and St. Louis is considerable and likely to grow, especially as the culture of semi-tropical products increases in the South. It is a business, however, which must be done at low rates, as there is competition by water routes to many of the places, and however great may become the volume of the traffic, it will probably never give a large profit. The passenger traffic is likely to be considerable, the more so as the railroad lies close along the old "emigrant trail," which is the short route by which immigrants to the Northwest from the South—Kentucky and Tennessee especially—made their journey with their wagons before the days of railroads, and is more direct than any other railroad route.

But the through traffic, and, indeed, all the traffic of this railroad, will depend largely on its connections with the East. It is in that direction that a large part—probably the largest part—of the surplus produce of the country on its line must find a market. It has excellent connections on the west—all the railroads diverging from St. Louis—and abundant ones to the north, the Evansville & Crawfordsville, the Springfield & Illinois Southeastern, the Illinois Central, the Chicago & Alton, the Rockford, Rock Island & St. Louis; but the bulk of its through business will depend largely on its ability to carry Eastern freight to and from the lines entering St. Louis from the West. At present, its connections for this business are imperfect, and, therefore, its exertions now are to secure Southeastern rather than Eastern traffic. But with the completion of its line to Louisville and the line which is to connect that city with the Chesapeake & Ohio Railroad, it will afford a route quite as short as any other between St. Louis and the seaboard, and this, as well as other roads in progress, will give its Evansville line a similarly favorable outlet to the East. Having, then, favorable connections with nearly all the markets of the country on its line, it will be best able to command its freight. No line is satisfactory which is adapted to carry to only one or two markets. If the road can take cars at any of its stations on their way either to St. Louis, Chicago, Evansville, Nashville, Louisville, Cincinnati, Pittsburgh, Norfolk, Baltimore, Philadelphia, New York or Boston, it will be able to accommodate nearly all customers, and will have little to fear from any rivals.

From a recent report of the President of the company to the stock and bond holders, we learn that it has now completed, or in course of construction, 28 substantial depot buildings, 14 water stations, 5 engine houses, 2 machine shops stocked with tools, 20 tool houses, and 5 section houses, which have cost in the aggregate about $195,000.

It has also both in Evansville and Shawneetown valuable water frontages on the Ohio, and depot grounds in East St. Louis, Mount Vernon, Evansville, etc., which are worth $300,000.

The equipment of the road consists of 18 locomotives, 13 passenger cars, 6 baggage cars, 1 pay car, 5 caboose cars, 220 flat and coal cars (100 more under construction), 134 box and stock cars (100 more under construction), and 82 hand and rubble cars, the aggregate cost of which has been $509,055.

The value of the road-bed and superstructure the President estimates at about $5,325,000.

These estimates make the value of the property owned by the company about $6,330,000, which is at the rate of $31,336 per mile of road.

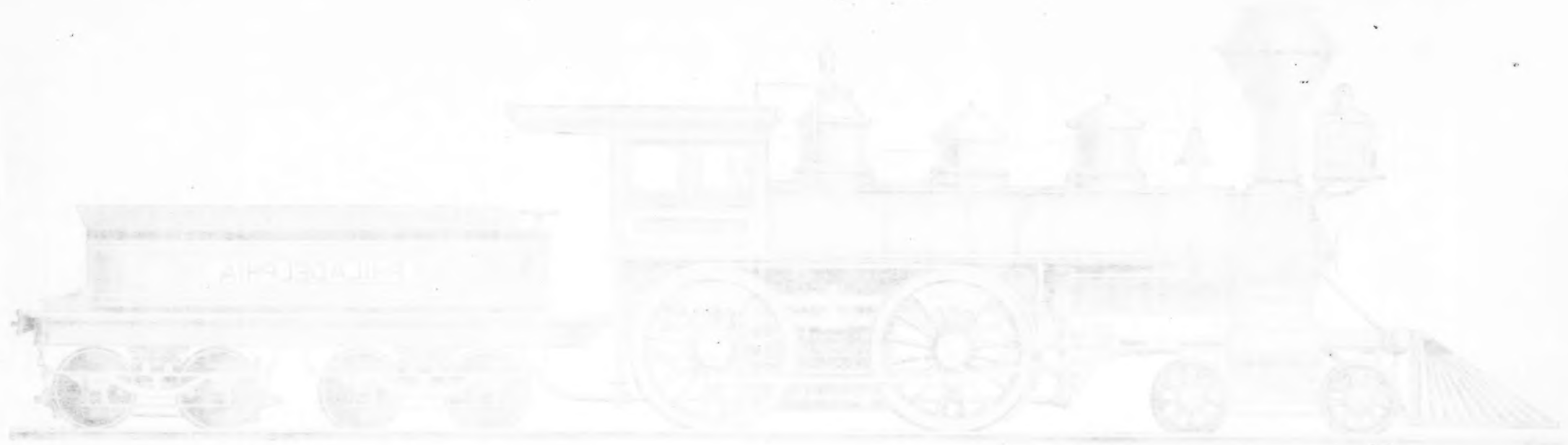
The Eastern Terminus of the Union Pacific Railroad.

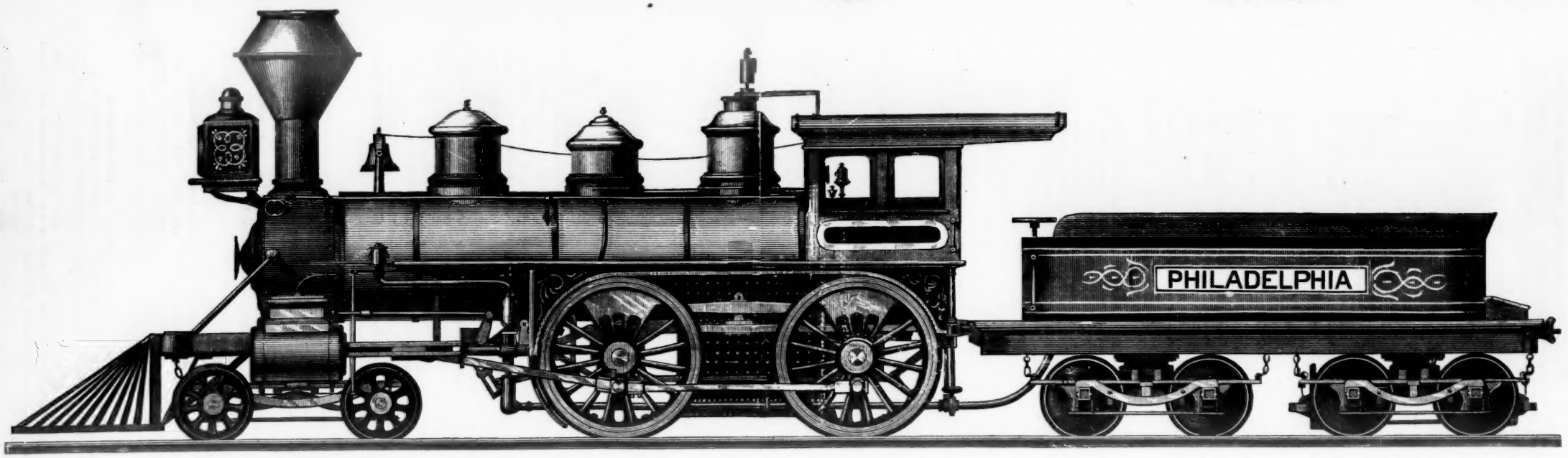
The Union Pacific Railroad was begun on the west bank of the Missouri River at Omaha, and has had its terminus there. Indeed, without the expenditure of a million or two and a delay of one or two years for the construction of a bridge, it could not have its beginning on this side of the Missouri. But ever since it was begun or talked of there has been a a fierce contention between Omaha and Council Bluffs, the town on the opposite side of the Missouri, as to which should be made the permanent point of transfer between the Union Pacific and the railroads to the East. So long as the Missouri remained unbridged, the question was one of comparatively little importance, for the work of transferring has to be done on both sides; but in consideration of the probable completion of a bridge soon, it became a matter of real importance to these two towns whether the trains of the Eastern roads should run through to Omaha and there connect with the Union Pacific, or discharge their passengers and freight at Council Bluffs, where the Union Pacific trains would be made up. Indeed the question was, which of the towns shall be the terminus of a system of railroads and which a way station. It would seem that the question was one easy to solve, as the action of the company would determine it instantly and irrevocably. But it has seemed impossible to know what the company intended to do. It had a very large tract of land in Council Bluffs which would be comparatively valueless—to sell for city lots—unless that town were the terminus; but it also had a large amount of land in Omaha, which would be considerably depreciated in value should the terminus be removed to Council Bluffs. It was, apparently, master of the situation; for it had a charter for a bridge, and without it could receive from and deliver to its connections either at Omaha or Council Bluffs. Until a little more than a year ago Omaha was confident. Some changes in the management were made, and shortly afterward it was claimed that Council Bluffs was in the ascendant. The work of constructing the bridge was renewed with some vigor, it was announced that plans were completed for a great terminal station on the Iowa shore, and there really seemed good reason to believe that the company intended to make its terminus there. Omaha and the county in which it is situated were so satisfied of this fact that they refused to deliver certain bonds and lands which they had subscribed to the company in consideration of its making its terminus in Omaha.

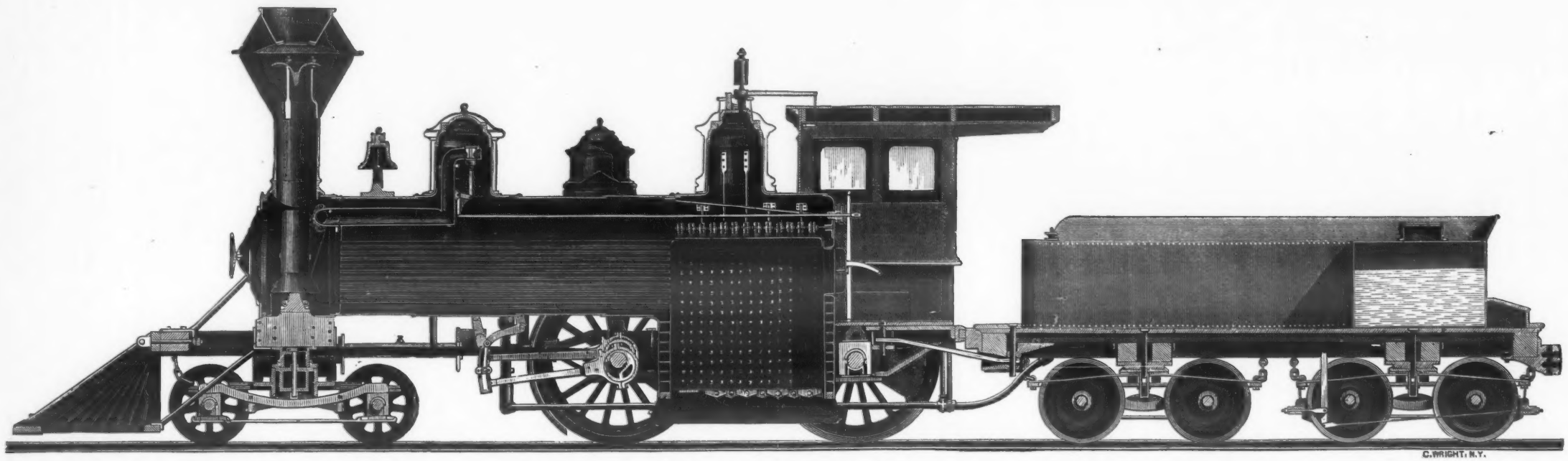
Now it is announced that at a meeting of the Executive Committee of the company, held in New York on the 16th inst., it was decided, in consideration of the delivery of the bonds and lands in question, to be made on the 1st of January next, that the company will construct all its terminal stations in Omaha and maintain there the general offices of its operating department and its land department, make up there all trains bound westward, and transfer there all cars of connecting roads without delay or discrimination.

This is supposed to settle finally the question of the terminus. But with this, one may think, the connecting railroads may have something to do. All of these which exchange any appreciable amount of freight with the Union Pacific have their termini in Council Bluffs, and they can carry freight and passengers no further west. They have, we understand, no share in the bridge now in progress between Council Bluffs and Omaha, which is wholly controlled by the Union Pacific. If they can agree with that company, they may, it is true, run their trains over its bridge into Omaha; but that depends upon their pleasure. If they see fit to have their termini in Council Bluffs, nothing that the Union Pacific can do can prevent them; and if they fix their termini in Council Bluffs while the Union Pacific has its in Omaha, if the latter wants their traffic nothing would seem to remain for it but the operation of its railroad over the bridge as an independent line, by doing which "termini"—such as they are—can be made sufficiently numerous to please all parties.

Until the business of the Union Pacific has increased very greatly, however, the town which has its chief construction and repair shops and its general offices is likely to be more benefited by them than by the transfer of its traffic. It seems not to be generally understood that the business of the Union Pacific, in comparison with that of other prosperous railroads, is very light. But of course Omaha and Council Bluffs count more upon what its traffic will be than on what it is.







STANDARD LOCOMOTIVE ENGINE,

BUILT BY THE

Baldwin Locomotive Works, Philadelphia.

The Erie Railway Report.

Everything concerning this railroad is supposed to partake of the mysterious and the unaccountable, and consequently its operations excite more interest than those of other companies equally or more important, which never do anything out of the common way, and consequently are never marveled at and watched and investigated.

During the present week the annual statement of the earnings and expenses of the Erie Railway, as reported by its Auditor, has been made public. The figures are as follows, the year closing September 30 :

	1871.	1870.
Gross earnings from all sources....	$17,168,005 16	$16,179,461 66
Operating expenses, 72½ per cent. of the earnings.....	12,446,355 87	12,073,010 89
Net earnings.....	$4,721,649 29	$4,106,450 97
Interest on mortgage debt, rents, taxes, insurance, etc.....	3,908,603 93	4,012,001 61
Profit.....	$813,045 36	$94,449 16
Less loss operating Atlantic & Great Western Railway....	694,780 71	386,470 79
Net profit.....	$118,264 65	Loss...$292,021 43

We could wish that the statement was more in detail, but it is very well as it is. It is cheering to observe that the company's exertions have been so far rewarded that the profits of this year will balance two-fifths of last year's loss. The increase in net profits is, indeed, more than $410,000, and ever so many hundred per cent, at which rate the liveliest imagination and the best calculating machine cannot estimate the immense profits in future years.

In gross earning an increase of very nearly a million dollars is reported, which is about 6¼ per cent. These receipts are at the rate of $24,300 per mile, which is about $9,000 less than the Pennsylvania Railroad earned last year, and nearly $6,000 per mile less than the New York Central reported for 1869–70, but greater probably than any other railroad in America more than 200 miles long has ever earned.

It is interesting to see how nicely the receipts of this company adjust themselves to its expenses. Year before last there was a little balance of half a million, we believe; but of course this was a trifling amount to work such a property with, and not worth considering in connection with a dividend on a share capital of $83,000,000. And it was well it was kept, else last year's deficit of nearly $300,000 might have been much larger, and then the self-sacrificing men who made good the company's losses and advanced it means to keep it in operation might have suffered or been completely ruined, which would have been sad. Now, this year the debit and credit columns are more nearly even than ever, only a paltry hundred thousand or so remaining to start the year on.

Although few details are given in the report, we are told that one of the instruments in impoverishing Erie has been the Atlantic & Great Western Railway. Fortunately we can say "has been" and not "is." The Erie Company has been operating this road under a lease, and paying 30 per cent. rental. Now this is not usually a high rental, and in this case the Atlantic & Great Western proprietors have complained bitterly that the rental was entirely insufficient and quite insignificant. But how plain a tale has put them down. Here we have figures—figures that won't lie—Erie figures—which show in black and white that not only is there no profit in operating the Atlantic & Great Western for 70 per cent. of its gross receipts, but a positive loss, which last year amounted to $386,000, and this year to $694,000. The Erie Company is therefore to be congratulated on getting rid of this costly encumbrance, the loss in operating which will hereafter fall upon its proprietors, who have been bold enough to take it into their own hands again. This was the more serious because the loss increased so fearfully, that for the last year being 80 per cent. greater than the loss in the year previous, at which rate, it is easy to see, the loss would have been $1,250,000 next year, in 1872–3 $2,250,000, in 1873–4 $4,050,000, in 1874–5 $7,290,000, and so on, so that by the close of the century the amount of the loss would almost exhaust even the capacity of Arabic numerals to represent and the resources of the Erie Railway Company and its managers to pay.

A Chicago Suburban Railroad.

A company called the "Chicago, Lake View & Evanston Railroad Company" has been organized in Chicago to construct a railroad for suburban traffic from Chicago north near the lake shore to Evanston, 13 miles. At a meeting of the stockholders held in Chicago on the 11th inst. the gentlemen whose names follow were elected as directors: Julius White, of Evanston; S. B. Chase, Lake View; Walter B. Scates, Evanston; F. J. Howe, Lake View; William Lill, Chicago; Wilson Phelps, Evanston; J. B. Adams, Evanston; Merrill Ladd, Evanston; E. A. Gage, Evanston; T. C. Hoag, Evanston, and W. K. Nixon, Chicago. Merrill Ladd, Isaac R. Hitt and T. A. Cosgrove, of Evanston; H. G. Chase and F. S. Howe, of Lake View, were chosen commissioners to fulfill the requirements of the law, and Merrill Ladd was chosen Treasurer. The capital stock is $500,000.

The company proposes to construct a road about midway between that of the present Chicago & Milwaukee line and the lake shore. It has secured right of way through the towns north of Chicago, and proposes to have its terminus in Chicago about the corner of Indiana and North La Salle streets, which is close to the entrance to the tunnel, and a little more than half a mile from the Court-house. The country on the line is well situated for suburban residences, and, indeed, has a great many already; but the numerous cemeteries occupying the best ground on the route will have some effect in preventing a great increase of villages; and as the Northwestern already serves all these places with frequent suburban trains at high speed, the proposed line will have to meet with severe competition, the more so as it will depend wholly upon the receipts from the suburban traffic, while the Northwestern can do that business at a loss even without affecting materially its gross income, and perhaps with considerable advantage to its traffic in future years. The proposed road, however, will accommodate a considerable district in Lake View now dependent upon the street cars. It is not intended, we suppose, to make the new line a heavy railroad, but a tram-road (at least in the city), operated with light dummy engines. Otherwise, it will not easily get an entrance into the city, as a railroad down La Salle, or one of the streets near, would very greatly injure the value of property. But if steam "dummies" are to be allowed to run on this proposed road in the city, why should they not be admitted upon the old street railroad on North Clark street, which now uses them on some miles of line in Lake View, and doubtless would be glad to have its cars run by steam as fast as the authorities would permit from Graceland to the Chicago River.

It is thought that the prohibition of frame houses in the part of the city where the less wealthy (not to offend them by calling them poorer) people have lived will cause a great increase in the growth of all suburbs which can offer reasonably quick and frequent communication with the city, and perhaps a suburban railroad may be made profitable to those who own suburban land, even if its traffic were unprofitable, as it very likely would be for some years at least. To make suburban traffic profitable in a city no larger than Chicago, it should be monopolized as much as possible by one line. A company might carry 2,000 passengers daily between Chicago and Evanston for ten cents a ride at profit, when it might lose largely by carrying at twenty cents a ride 200 passengers daily. As there are a great many railroads entering Chicago, nearly all with some suburban traffic and anxious to make it greater, it is very improbable that any one line will secure what might properly be called a large traffic, and any new road has not only to compete with that which reaches the same towns, but with every other railroad which has suburban towns on its line. The suburban population is divided by the number of suburban towns, and as there are a great many about Chicago, and there are not a great many people who can be induced to live out of the city, the average number of people per town is not large.

NEW PUBLICATIONS.

Profile Field Book.—This is a convenient field book, useful in preliminary surveys and in location, enabling the engineer to dot down the profile as fast as the levels advance. It also affords the engineer the means of having his profile always in connection with his "line" notes. It is published by William J. Young & Sons, No. 43 North Seventh street, Philadelphia.

Campbell's Shippers' Guide.—Mr. R. A. Campbell has the honor of being the first to publish a volume in Chicago since the great fire. He has recently issued a new edition of his valuable "Shippers' Guide," which had become almost indispensable to a large class of Chicago merchants, and which most of them lost in the fire with their stores and offices. The new edition was manufactured hastily, of course, but that is one of its best qualities to those who have been waiting for it.

—Several of the members of the contracting company which is constructing the Northern Pacific Railroad were snowed in for three days at a point on that road about twenty miles east of Fargo, where this road crosses Red River. They were in one of the contracting company's cars, which is provided with berths, cooking apparatus and provisions, and the ties along the road supplied them with fuel, which was then a necessity of life, as the thermometer went down to 30 degrees below zero or more.

Standard Locomotive with 16x24 in. Cylinders.

We give with this number engravings of a standard locomotive with 16x24 in. cylinders, as constructed by the Baldwin Locomotive Works, Philadelphia, M. Baird & Co., Proprietors. We hope to give others of similar engines by the other locomotive firms in America in the next few months. The following is the specification :

Specification of an eight-wheeled road locomotive engine, having four coupled wheels and a four-wheeled swing bolster truck; for the —— railroad company.

GENERAL DESCRIPTION.

Cylinders, 16 inches diameter and 24 inches stroke. Drivers, 60¾ inches diameter. Gauge, 4 feet 8½ inches. Fuel, wood or soft coal. Weight of engine in working order with fuel and water, about 65,000 pounds; about 41,000 on drivers. Total wheel-base, 21 feet 9 inches. Rigid wheel-base, 8 feet. General design illustrated by the engraving.

BOILER

of the Pennsylvania cold-blast charcoal iron, 3-8 inch thick; all horizontal seams and junction of waist and fire-box double-riveted. Boiler to be well and thoroughly stayed in all its parts, provided with cleaning holes, etc. Waist, 48 inches in diameter at smoke-box end, made straight and with two domes. Flues of iron with copper ferrules on fire-box end, 144 in number, 2 inches in diameter, and 11ft. 5in. in length. Fire-box, 66 inches long and 34½ inches wide inside, 63 inches deep, of best homogeneous cast steel; side, crown and back sheets five-sixteenths inch thick; flue sheet one-half inch thick. Water space three inches sides and back, four inches front. Stay bolts seven-eighths inch diameter, screwed and riveted to sheets, and not over four and one-half inches from center to center. Crown bars made of two pieces of iron four and one-half inches by five-eighths inch, bearing on side sheets, placed not over four and one-half inches from center to center, and secured by bolts screwed through crown, with nut on, and riveted over. Grates, cast iron. Ash pan, with double dampers. Smoke-stack, diamond pattern.

CYLINDERS

placed horizontally; each cylinder cast in one piece with half saddle; right and left hand cylinders reversible and interchangeable; accurately planed, fitted and bolted together in the most approved manner.

PISTONS

fitted with two brass rings babbited.

GUIDES

of iron, case-hardened, fitted to guide-yoke extending across.

VALVE MOTION.

Most approved shifting-link motion, graduated to cut off equally at all points of the stroke. Links made of the best hammered iron well case-hardened. Sliding block 4½ inches long with flanges 7 inches long. Rock shafts of wrought iron with journals 3½ inches diameter and 12 inches long. Reverse shaft made with arms forged on.

DRIVING WHEELS,

four in number; 60¾ inches in diameter. Centers of cast iron, with hollow spokes and rims, and turned to 56 inches diameter to receive tires. Tires of cast steel, all flanged, 5½ inches wide and 2⅝ inches thick when finished. Axles of hammered iron; journals, 7 inches diameter and 8 inches long. Wrist-pins of cast steel. Springs of best quality of cast steel. Connecting rods of best hammered iron, furnished with all necessary straps, keys and brasses, well fitted and finished. Equalizing beams of most approved arrangement, with steel bearings.

FRAMES

of hammered iron, forged solid. Pedestals cased with cast-iron gibs and wedges to prevent wear by boxes.

FEED WATER

supplied by one No. 5 injector and two pumps, with valves and cages of best hard metal accurately fitted. Plunger of iron. Cock in feed pipe regulated from foot board.

ENGINE TRUCK.

Frame, square wrought iron, with center bearing and swing bolsters. Wheels of approved pattern, 28 inches diameter. Axles of best hammered iron, with inside journals 4½ inches diameter and 7½ inches long. Springs of cast steel, connected by equalizing beams.

CAB

of good pattern, substantially built of hard wood, well finished and fitted to place.

PILOT

of wood.

FURNITURE.

Engine to be furnished with sand box, alarm and signal bells, whistle, two safety valves, steam and water gauges, heater and gauge cocks, oil-cans, etc., etc. Also a complete set of tools, consisting of two jack screws, pinch bar, monkey, packing and flat wrenches, hammer, chisels, etc.

FINISH.

Cylinders lagged with wood and neatly cased with brass. Heads of cast iron, polished. Steam chests with cast-iron tops; bodies cased with brass. Domes lagged with wood, with brass casing on bodies and cast-iron top and bottom rings. Boiler lagged with wood and neatly jacketed with Russia iron secured by brass bands polished.

GENERAL FEATURES OF CONSTRUCTION.

All principal parts of engine accurately fitted to gauges and thoroughly interchangeable. All movable bolts and nuts and all wearing surfaces made of steel or iron case-hardened. All wearing brasses made of ingot copper and tin, alloyed in the proportion of seven parts of the former to one of the latter.

TENDER

on 8 wheels, 30 inches diameter; axles of best hammered

iron; outside journals, 3¼ inches diameter and 6 inches long; oil-tight boxes with brass bearing. Springs of cast steel equalized. Tank well put together, with angle-iron corners and strongly braced. Top and bottom plates of No. 6 iron; side plates of No. 8 iron. Capacity, 2,000 gallons.

PAINTING.

Engine and tender to be handsomely painted and varnished.

Regulations Concerning Free Passes.

A meeting of representatives of sixteen railroad companies, chiefly those having termini in St. Louis or close relations with those which have, was held in St. Louis on the 12th inst. The following companies were represented:

North Missouri, by W. R. Arthur, General Superintendent.

Missouri Pacific, by Jos. Brown, President; T. McKissock, General Superintendent.

Iron Mountain, by Thos. Allen, President; A. W. Soper, General Superintendent.

Atlantic & Pacific, by A. A. Talmage, General Superintendent.

Kansas Pacific, by E. S. Bowen, General Superintendent.

Missouri, Kansas & Texas, by F. S. Bond, Attorney in Fact.

St. Joseph & Denver City, by J. F. Barnard, Superintendent.

Kansas City, St. Joseph & Council Bluffs (by letter), A. S. Hopkins, General Superintendent.

Chicago & Alton, by J. C. McMullin, General Superintendent.

St. Louis, Vandalia, Terre Haute & Indianapolis, by J. E. Simpson, General Superintendent.

Ohio & Mississippi, by A. W. Chrystie, Vice-President.

Indianapolis & St. Louis, by E. W. Woodward, President.

Illinois Central, by A. Mitchell, General Superintendent.

Toledo, Wabash & Western, by A. Anderson, Vice-President; G. H. Burrows, General Superintendent.

Leavenworth, Lawrence & Galveston, by O. Chanute, General Superintendent.

St. Louis & Southeastern, by John Lee, Jr., Superintendent.

Hon. Joseph Brown, President of the Missouri Pacific, was chosen President, and John Lee, Jr., Superintendent of the St. Louis & Southeastern, Secretary. The object of the meeting was to establish some general regulations concerning the issue of free passes. The following were adopted:

Article 1. That the usual reciprocal, annual passes between officers of connecting lines may be given.

Art. 2. That time and trip passes to traveling agents or employes of other roads shall only be granted on a letter from the president or superintendent or other general managing officer for each particular case, addressed to the president or superintendent or other managing officer whose pass is solicited, and such letter shall only be given for business purposes.

Art. 3. Half fare tickets to clergymen shall only be issued to those living on line of road engaged in preaching the gospel, or a pastor of a church, and have no other business or occupation.

Art. 4. Passes for purely charitable purposes may be given.

Art. 5. Any and all passes embraced in these rules to be issued shall be signed by the president, general superintendent or general managing officer of the roads giving such passes.

Art. 6. Passes shall not be given to shippers of freight, hotel-keepers or clerks, or on account of business of any kind, except as otherwise provided for.

Art. 7. One man may be passed on the train with his stock for one or two cars; two men for three cars to seven, inclusive; and three men for eight cars or more, which is the maximum number that may be passed with stock for one owner, and no return passes will be given on account of stock shipments. It is understood that stock passes are given for the purpose of having the men go with and take care of their stock, and not as an inducement to ship on the line.

After the adoption of these regulations, the following committee was appointed to call a meeting of the presidents, superintendents or other general managing officers of Western railroads, in January, for the purpose of forming an association of presidents and superintendents of Western and Southern railroads, having for its objects the advancement of railroad management and the promotion of railroad interests throughout the West and South:

J. E. Simpson, St. Louis, Vandalia, Terre Haute & Indianapolis Railroad; W. R. Arthur, North Missouri Railroad; J. C. McMullin, Chicago & Alton Railroad; A. A. Talmage, Atlantic & Pacific Railroad; A. Mitchell, Illinois Central Railroad; E. S. Bowen, Kansas Pacific Railway; W. K. Muir, Great Western (of Canada) Railway; J. D. Layng, Pittsburgh, Cincinnati & St. Louis Railroad; Albert Fink, Louisville & Nashville Railroad; L. J. Fleming, Mobile & Ohio Railroad; D. McLaren, Cincinnati, Hamilton & Dayton Railroad, Dayton & Michigan, and Cincinnati, Richmond & Chicago railroads; Chas. F. Hatch, Lake Shore & Michigan Southern Railway; E. Q. Sewall, New Orleans, Jackson & Great Northern Railroad; E. W. Cole, Western & Atlantic Railroad.

The meeting then adjourned to December 26.

Northern Pacific Land Grant.

The St. Paul *Press* says, speaking of Col. John S. Loomis, the Land Commissioner of the Northern Pacific Railroad Company:

Since the latter part of August he has had some twelve parties of examiners in the field, operating under his personal supervision, he himself, with a select party of surveyors, having been engaged for some two months in making a general exploration and inspection of the lands of the company. Since this work was inaugurated 1,529,000 acres of the company's lands have been examined and platted in accordance with the instructions of the Commissioner, which required a system of examination and descriptive platting and field-notes far more thorough than was ever before attempted. Every forty-acre lot in this large area has been thoroughly inspected—all its topographical features delineated on the plats and field-notes in the minutest detail—each plat being a perfect photograph of each section and all its subdivisions, of its streams, lakes, swamps, woods; and showing the ploughed land, however small in quantity; the houses of settlers, the roads and trails, while the field-notes comprising a minute description of each tract, of the nature of the surface—even the direction of the slopes, the kind and quality of soil, the character and depth of the streams, the quality of the water, the amount, quality and size of timber, building material, the yield of grass on the meadows, and all other features which intending settlers might desire to know before purchasing. In addition the names of all settlers or claimants of lands are given—their improvements minutely described.

Since his return on the 10th inst., Col. Loomis has had a large force of draughtsmen engaged in transferring these plats and field notes to maps, using for the purpose the plats of the United States survey, and correcting them by and adding to them the immense variety of topographical detail collected by his examiners.

The work is so elaborate and so minute and precise in its details that it requires an immense amount of patient and skilful labor to execute it, but Col. Loomis proposes to so augment the force at work as to compress within ninety days the work which would ordinarily require, perhaps, a couple of years to accomplish it, and he proposes to have some 850,000 acres of the examined lands regularly listed and ready for appraisement by the Board in January. When completed, the maps and accompanying field notes will be infinitely more perfect and minutely accurate pictorial and written descriptions of the lands of the company than was ever before attempted either by the government or any State or railroad corporation as the basis of a land policy. So minute, thorough and exhaustive, indeed, is the information conveyed, that every separate tract can be appraised with a thorough knowledge of all its elements of value; and the intending settler can purchase a tract of land at New York with as thorough a knowledge of all its topographical features and all its features of soil, water, woods, grass, roads, cultivation and general appearance, neighborhood, &c., as if he had personally inspected it; and, indeed, with a more thorough knowledge than most settlers, not experts in the business, could derive from any ordinary personal inspection. So far as that portion of the land grant within the limits of Minnesota is concerned, the Land Department will be thoroughly prepared for active business this winter, and during the coming year will be ready to meet any demand for lands by colonies or individual settlers to the extent of two million acres. The whole land grant of the Northern Pacific Railroad in this State, exclusive of the St. Paul & Pacific, is 3,200,000 acres. The same system of examination is to be applied to the even sections of government lands, and the information thus desired to be placed gratuitously at the service of all those who desire to avail themselves of the free homestead laws of the United States to settle upon those lands, the policy of the company being to encourage the settling and cultivation of the homestead lands along their line as rapidly as possible. Next year this system of examination is to be extended to the odd and even sections within the limits of the company's grant in Dakota—there expanded to forty miles in width—and ultimately, with the progress of the road and the United States surveys, to the whole belt of 72,000,000 acres across Montana, Idaho, Oregon and Washington to Puget Sound.

RAILROAD LAW.

—Judge Price, of Nashville, Tenn., in his charge to the jury who were trying a brakeman, charged with manslaughter, through negligence which caused a fatal accident on the Louisville & Nashville Railroad, defined as follows the nature of the responsibility which rests upon railroad officers and employes:

"If the rules established by a company for the running of cars should conflict with the laws of the land, the parties running the cars should disregard the company's rules and conform to the law. If the engineer and conductor of a train should attempt to run by a stationary train at an unusual and dangerous rate of speed, and a switch was displaced, and a collision should occur, and death should result, both engineer and conductor would be guilty, under the law, of a felony, and could be punished by a jury, with death by hanging, or by imprisonment in the penitentiary for a long term of years.

"If an engineer and conductor should run their train upon another train's time, and a collision should take place, and death result, the engineer and conductor so unlawfully running their train would be guilty of murder, and a verdict of death would be a just one.

"In the running of cars it is necessary that there should be brakes, and they should be manned by trustworthy and able-bodied men. If a brakeman should willfully do anything that would cause a collision and death resulted, he would likewise be guilty of felony, and for the safety of travelers, and for the good of all, he should be punished. Railroad officers are presumed to know their duty, and all are presumed to know the law."

—A horse railroad in Alton, Ill., was constructed according to the directions of the engineer of the city. Sufficient water-way not being provided in one of the culverts, an adjoining garden was flooded. The owner of the garden sued the company for damages. It contended that as it followed the directions of the city engineer, as the law directed them to, it should not be held responsible. The Supreme Court of Illinois (50 Ill., 210) decided against the company, using the following language in its opinion:

"When the city prescribed the limitations under which the company could lay their track, it was for them to determine whether they would proceed or abandon the enterprise; it was for them to say whether it would be to their present or future advantage to accept the terms, with the liability to damages to others growing out of the terms imposed by the city, and proceed with the work. When they adopted the conditions imposed by the city, and plans prescribed by its engineer, appellants made them their own. They were free to accept or reject them, and, having accepted them, they are responsible for the damages resulting to others by the construction of the road, to the same extent and precisely as though the plan had been suggested and carried out by an engineer of their own.

"Whether the city or its engineer is liable over to appellants is a question not presented by this record, and we therefore refrain from discussing it."

—G. N. Palmer, traveling agent for a New York firm, has recovered $3,000 from the Charlotte, Columbia & Augusta Railroad, for ejectment from the cars of that road. He had a through or coupon ticket, and had the coupon belonging to the Charlotte road taken by the conductor, receiving from the latter a check. Palmer got off at a way station, and when he went on another train the next morning, the new conductor refused to recognize the check, and ejected Palmer from the car. The case was decided in the Augusta, Georgia, Court of Common Pleas.

THE SCRAP HEAP.

Plan for Cheap Railroads.

Mr. William B Hyde, a San Francisco engineer, has invented and patented a plan for cheap, light railroads, which he describes as follows in a pamphlet which he has published:

"We require a railway which shall be able to sustain loaded freight cars from the parent road at speeds of 5 to 6 miles an hour, and a special class of very light passenger cars at speeds of 10 or 12 miles an hour, and a locomotive power so disposed as to haul the above without demanding a 45, 56 or 60 lb. rail for its service.

"To accomplish this end I propose that very slight roadways be built as near the surface of the ground as possible within grades of 200 feet per mile, and with a superstructure of ties 2½ inches x 8 inches, usual length, surmounted by longitudinal rail stringers of straight Oregon pine or other good wood of 3½ inches x 6 inches deep, surmounted by a good strap iron, with ends spliced with an underneath fish-bar let into the surface of the wooden under-rail and bolted entirely through the same. Or a 10-lb., 15-lb. or 20-lb. iron T rail. With such a rail the work which I have enumerated above can be easily and safely done. Between the rails I construct a strip of flat roadway 18 or 20 inches wide at top, and which is about flush with the plane of the side rails. This strip to be manufactured of any material cheapest to the country in which the same may lie, be it stone or wood, asphaltum or McAdam. Upon this center strip of roadway will operate a broad elastic-tire traction wheel, having just sufficient weight of the engine resting upon it to utilize every pound of steam that the cylinders receive from the boiler, permitting the remaining weight of locomotive to be so distributed by truck-wheels as to bear upon the track very lightly and afford guidance to the locomotive. I make the center strip of equal height with the side rails, so that at all junctions or switches the traction wheel can traverse without obstruction from one track to another."

Glass Bearings.

A correspondent writes to *The Engineer* to inquire whether glass "has ever been used successfully for the wearing surface of machinery," and what lubricant is used.

In reply we can say that Harden's glass bearings for cross-heads have been in successful use in this country since 1867, and there are now about 2,000 engines running on which they are used.

Drunk.

The Engineer says: "At the Cheshire quarter sessions on Tuesday, Edward Jones, railway engine-driver, and Reuben Fowler, stoker, were tried on charge of being drunk while on duty, and allowing their engine to stand on the main line of the London & Northwestern Railway at Birdswood Junction, whereby a collision was caused. Jones was sentenced to twelve months' and Fowler to four months' imprisonment with hard labor." Served them right, says the RAILROAD GAZETTE.

Backwoods Railroading.

There is a railroad of primitive design, though only a year or two old, between the ancient city of St. Augustine, Fla., and Tocoi, on the River St. John, the chief use of which is to transport tourists between that very old and very lifeless town and the steamboats on the St. John. A New England lady, describing her journey to St. Augustine, writes that the hardest part was the last fifteen miles before reaching St. Augustine. They cut the wood as they went through the woods, and watered the engine by dipping up the water in buckets at the roadside; when they got up steam enough to get off, the same hands ran on before to sprinkle sand on the wooden rails, in order to travel the distance of fifteen miles in four and a half hours. She says she was thoroughly provoked, as the road was built by a Connecticut Yankee and run by him.

Glass Gauges.

A correspondent of *Engineering* says that an improved form of gauge has been lately introduced with a view to reduce the fracture of gauge glasses so common. By the new arrangement two tubes are employed, one fitting within the other, so as to leave an annular space around the inner tube, which is of course filled with air. These tubes are mounted in the ordinary manner, and it is found that they are far less liable to break as the inner one is protected from the sudden changes of temperature by the outer tube and the stratum of air contained in the annular space.

Myers' Pneumatic Locomotive.

The North Chicago Railway Company is about to put two of these engines, which were described in the RAILROAD GAZETTE last September, on their railroad. Mr. Myers is also constructing one for the Russian Government.

Chicago Railroad News.

Chicago & Northwestern.

The work of track-laying on Menominee Extension of the Chicago & Northwestern Railway is progressing satisfactorily. Trains are now running as far as Peshtigo. The road will be open for business to Menominee, 50 miles north of Green Bay, by the 1st day of January.

This company expects to add largely to its equipments during the next year. It has already contracted for 500 new freight cars to equip the new lines and to meet the increasing wants of the public on the old lines. There is no railroad line running out from Chicago that more fully understands the wants of the public or is more prompt to respond to them.

About 20 miles of steel rail have been laid on this road, all the road in the city limits being of steel. The company will add more of this rail as the present track requires renewal. The company has commenced the laying of steel rails for the entire length of the Dixon Air Line, commencing at Chicago.

The branch from Madison to La Crosse, known as the Madison Extension, is being rapidly constructed. The bridge at Reedsburgh, which has been constructed by Fox & Howard, of Chicago, was put on board the cars for Reedsburgh on Saturday, the 16th inst. It is a single span of 160 feet, and will be immediately put in place, when the line will be opened to Reedsburgh. About the first day of January the line will be opened to that point.

The grading is done to within a short distance of Wonewoc, 12 miles beyond Reedsburgh, and will be completed to that point within two weeks. This will leave some 70 miles to be built before the terminus at La Crosse is reached. This latter section of road will have three extensive tunnels to be constructed, a short distance east of La Crosse—one of 3,000 feet in length, another of 1,300 feet, and another 4,600 feet in length, and it is not easy to make an estimate as to the time which will be required to excavate these. The rock to be excavated is a somewhat porous and friable sandstone, which will not offer great resistance.

The Chicago & Northwestern Railway Company have, during the past week, consummated the purchase of a large strip of land on the West Branch of the South Branch of Chicago River, for the purpose of establishing there their lumber business. This ground is technically within the city limits, but is beyond the built-up portion of the city, and not far from the new city Bridewell. It is understood now that the lumber business of the city must be done at such places as to avoid endangering the destruction of the city by fire. The ground purchased is where the company can lay all the tracks they choose and not interfere with any one's rights.

It is not generally known that Hon. William B. Ogden has been for the past year dredging a ship canal to connect the Desplaines River with the West Branch of the South Branch of the Chicago River. This canal will be completed some time during next season, and will furnish dockage room for an immense timber business; and it is believed to be Mr. Ogden's plan to connect the ground along this canal with the several railroad lines entering the city, for the purpose of accommodating the immense lumber trade of the city.

Freights Westward.

Freight rates westward to Chicago have been advanced again, so that now they remain as follows: First class, $1 25; second class, $1 10; third class, 85 cents; fourth class, 65 cents; special, 50 cents.

The rates for dressed hogs from this city are at present as follows: To Albany, 75 cents; to New York, 80 cents; to Boston, 85 cents.

Michigan Central.

The Michigan Central Railroad Company on the 19th inst. announced a semi-annual dividend of 5 per cent. over and above all expenses of the road, including the interest on the bonds of the Company. This does not have any reference to the business of the branch lines of company. The company are about to issue an additional amount of bonds, equal to $2,600,000. This is one additional share for every six of the old shares held by the present shareholders.

This amount is to be applied to the construction of a double track for the entire length of the road from Detroit to Chicago, and for additional equipments. The company design to have the main line all laid with steel rails. The entire section of the road between Detroit and Jackson at present consists of steel track, 50 miles having been laid during the past season. The company have recently contracted for 5,000 tons of steel rails which are to be used during the next season. A portion of this comes from England, and some of it is of American construction.

Civil Engineers' Club of the Northwest.

This club met on the 11th inst., at which time a paper was read by Mr. Charles Paine on "Tile Drains for Railroad Work." A paper on "Locomotive Proportion," by Mr. M. N. Forney, editor of the RAILROAD GAZETTE, was also read. The meeting was one of considerable interest, and the club promises to regain its old status within a short period.

Illinois Central.

The new passenger house of the Illinois Central Railroad is just about finished. It will be opened to the public either during the holidays or by the first day of January.

The grain freight on the Southern portion of the Illinois Central road has largely increased within the past week or two, chiefly on account of the closing of the Mississippi River at St. Louis, the grain, having a permanent southern outlet at Cairo, appears to seek that point rather than the larger but more northern city of St. Louis, at least during the winter months.

The land office of the Illinois Central Railroad Company is now situated at Centralia, in this State, with a branch in Chicago. Alderman Peter Daggy, the Land Commissioner, has his office at Centralia, while the office in this city is under the direction of C. C. P. Holden. The Land Department of this company was in a building on Michigan avenue, which was supposed to be fire-proof. There were gathered and placed on exhibition specimens of the marvelous vegetable products of the soil of Egypt, including corn, oats, cotton, tobacco, &c., together with specimens of the soil from points all along the road. The company had a large Herring safe within the building, in which were stored notes to the amount of between $3,000,000 and $4,000,000, together with all the valuable papers of the company, including the original deed which conveyed the Illinois Central lands from the State to the Company. All these were totally lost. The plat books, comprising a complete description of the lands of the company, were, however, fortunately saved, and the deed itself is of course on file in the office of the Secretary of State at Springfield. The company has saved data sufficient to make good all the losses of documents, so that it will not be subjected to loss on account of being unable to reconstruct its accounts.

A New "Atlantic & Pacific" Company.

On the 15th inst., in the city of Elgin, a new railroad company was formed, called the "Atlantic & Pacific," with a view of constructing a road from Chicago nearly directly westward to the Mississippi, taking a line about half way between the Dixon Air Line Branch and the Wisconsin Division of the Northwestern, as far as Elgin, and thence to the Mississippi between the Air Line and the Freeport Line of the same company. The object now is to make the Mississippi terminus at Savannah. The officers of the company are: Col. R. M. Hough, of Chicago, President; Thomas Dobbins, Secretary; Chauncey T. Bowen, of Chicago, Treasurer; John S. Wilcox, George S. Bowen and —— Young, Directors. It is said that the people along the proposed line of road have subscribed stock already, or signified their willingness to do so, to the amount of from $4,000 to $5,000 per mile. The contractors for the work are Messrs. Fox & Howard, of Chicago, who have already ordered two locomotives and the necessary construction cars to begin work early in the spring.

Outside rumor, as usual, has it that this new road is to furnish a western outlet for the Pennsylvania Company; but there is, as yet, nothing definite to warrant such a conclusion.

New Depots.

The depot question is still about as it was, except that a bill has been introduced into the General Assembly, at Springfield, to enable the city of Chicago to sell the lake front and appropriate the proceeds to the general fund of the city. As it is now, if the property is sold, the proceeds can only be applied to park construction purposes, and few citizens are anxious to have the money so disposed of at present. If the bill passes, as seems probable, it is expected that the chief ground of opposition to the location of the depots on the Michigan avenue front will be obviated, and that the whole lake front will ultimately be bought by the railroad companies or be sold for business purposes, in which case the city may be placed on its financial feet again. There is little doubt but that the railroad companies now interested in the lake front will go into the West Division within a short period of time and build there a great union depot, unless something is done to remove the legal barrier to the purchase of ground on the lake front.

The Clark Street Bridge.

Clark street bridge is being rebuilt rapidly. The timbers are all framed and are now being put in place. By the second day of January the contractors say they will have it passable. That is just 60 days from the letting of the contract.

General Railroad News.

MISCELLANEOUS.

—The Chetopa (Kansas) *Advance* is responsible for the following "general order," which it gives as issued by the Missouri, Kansas & Texas Railway for the special benefit of the new town of Parsons:

"To all Employes: Engineers in approaching Parsons will indicate 'down brakes' by seventeen whistles; 'up brakes,' by thirty-four whistles; 'back up,' forty whistles and two snorts. In cases of doubt, whistle like the devil. At street crossings whistle considerably and ring the bell. Always whistle before dinner. Require the fireman to keep the whistle valve open during dinner. After dinner, whistle and squirt water, then back up, squirt a little, then go ahead with a whistle, a squirt and a ring. This order will be rigidly enforced."

In explanation of which it may be said that Chetopa was formerly the terminus and the most rapidly growing town on this road, but that Parsons, not many miles above, is the junction of its two chief lines, is growing rapidly, and claims the special favor of the company, which owns a large part of the place. And further, in explanation, it may be gently suggested to the very stupid that the editor of the *Advance* loves a joke.

—The House Congressional Committee on Pacific Railroads is composed of Messrs. Wheeler, New York; Buffington, Massachusetts; Lynch, Maine; Sypher, Louisiana; Killinger, Pennsylvania; Beveridge, Illinois; Houghton, California; Averill, Minnesota; Wells, Missouri; McKinney, Ohio; Smith Ely, New York; Harper, North Carolina; McHenry, Kentucky. The Committee on Railways and Canals consists of Messrs. Parker, Pennsylvania; Ames, Massachusetts; Halsey, New Jersey; Morris, Mississippi; Knapp, Illinois; St. John, New York; Biggs, Delaware; Winchester, Kentucky; Lomison, Ohio.

—The *Canadian Monetary Times* says:

"Street railways, so far as yet attempted in the cities of Canada, have been remarkably successful. Shares in the Montreal Company are quoted higher than Bank of Montreal stock, in fact, head the list, selling at 250 and upwards. The Quebec undertaking has also proved profitable, and the shares are at a premium. The Toronto Railway, for a long time in deep water, and afflicted with backslidings of the purse, and besides most unpopular with the citizens, has done well since it fell into the present hands. It is now settled beyond doubt that the new proprietors made a most profitable venture when purchasing the property. The annual profits are something handsome; indeed, it is believed that principal and interest have already been repaid out of surplus earnings."

ELECTIONS AND APPOINTMENTS.

—George W. Bartholomew, Vice-President of the newly completed Connecticut Western Railroad, has been appointed General Manager, to take charge of its operation.

—Col. S. L. Fremont has resigned his position as Chief Engineer and General Superintendent of the Wilmington & Weldon Railroad in order to give his whole attention to the Wilmington, Charlotte & Rutherford Railroad, of which he has been Superintendent for more than a year. Capt. John F. Devine, Master of Machinery of the Wilmington & Weldon road, is made General Superintendent.

—Since the New Jersey railroads have been put under the direction of Mr. A. J. Cassatt, he has the title of "General Manager" of the Pennsylvania Railroad, instead of General Superintendent as heretofore. His office has been removed from Altoona to Philadelphia.

—Mr. J. H. F. Wiers, formerly foreman in the Lake Shore & Michigan Southern Railway car shops at Norwalk, Ohio, and who for the past year and a half has been General Foreman of the Atlantic & Great Western Railroad car shops at Kent, Ohio, was recently appointed Master Car Builder of the latter road. Mr. Wiers is a gentleman of ability and experience, and is well qualified to fill the responsible position. Mr. S. V. Smith, of Rockford, Ill., has been appointed to fill the vacancy caused by for the promotion of Mr. Wiers.

—Mr. J. M. Lunt, Superintendent of the European & North American Railroad, has been appointed to the same position on the Maine Central. Mr. Lunt was formerly Superintendent of the Columbus, Chicago & Indiana Central.

TRAFFIC AND EARNINGS.

—Since the completion of the Lawrence & Pleasant Hill road, and its operation by the Missouri Pacific, the rates on freight from St Louis, in accordance with the contract made in leasing the line, have been made the same to Lawrence as to Kansas City, that is, 65 cents per hundred for first class and 26 on second class. Heretofore it has been 72 and 35 cents.

—The receipts of the Great Western Railway of Canada for the week ending November 24 were:

1871	£19,591
1870	16,413
Increase (19 per cent.)	£3,178

—The receipts of the Grand Trunk Railway of Canada for the week ending November 25 were:

1871	£41,600
1870	31,800
Increase (31 per cent.)	£9,800

—The Cleveland *Leader* says: "Navigation has now been practically closed for something like two weeks, and already we notice the usual complaints about a blockade of freights on the railroads. Toledo is particularly distressed, and the Board of Trade there is seriously considering some measure of relief. The fact as regards Toledo seems to be that, being the converging point of several railroads leading from the Western grain regions, Toledo, during the navigation season, supplies a large part of the New England market with grain, and that when the lake lines are cut off by winter, the pressure upon the Lake Shore road almost immediately exceeds its capacity. So it is at present. Toledo is full of grain, and there is much more awaiting shipment to that point, but the facilities for shipping eastward are entirely inadequate. Similar blockades exist on other roads and in other cities, the work of the great east and west lines of railway being in general greater than they can manage."

—Rutland finds that through the lease of the Rensselaer & Saratoga Railroad by the Delaware & Hudson Canal Company, it is to become the great coal center station of Western Vermont. Coal is now brought direct from the mines in Pennsylvania without breaking bulk.

—The earnings of the Marietta & Cincinnati Railroad for the second week of December were $37,327 in 1871, and $31,708 in 1870, showing an increase of $5,619, or 18 per cent.

—The earnings of the Pacific Railroad of Missouri for the first week of December, 1871, were $70,945, against $75,754 in 1870, a decrease of $4,809, or 6½ per cent.

—The Dubuque *Telegraph* says:

"The management of the Iowa Division of the Illinois Central Railroad and its branches will commence to enforce the rule adopted some time last spring to receive lumber for shipment only by weight, instead of by the car load, as heretofore. This will be unwelcome news to the consumers of lumber west of Dubuque, as it will materially enhance the cost of transportation of unseasoned timber of all descriptions. While this new regulation may be perfectly fair and legitimate, on the part of the railroad company, we cannot but regret that it should be deemed necessary, as it will certainly operate against the interests of our lumber trade. One of its first prejudicial effects will be made apparent in a decrease of sales of lumber from rafts, and an increased demand for that shipped to Chicago from the pineries by boat. A considerable business has been done, heretofore, at this point, in the shipment of green lumber from 'wild rafts,' which, under the new order of things, will hereafter be entirely cut off."

Certainly it is not a legitimate subject of complaint if more is charged for car-loads which weigh 22,000 pounds than for those which weigh 18,000.

OLD AND NEW ROADS.

Mont Alto.

It has been determined to construct a narrow-gauge railroad for the transportation of iron ore from the Mont Alto Iron Works in Quincy township, Franklin county, Pa., to the "Pond Banks," about ten miles.

Western Union.

This company's business has so increased of late that it has put on an additional freight train to accommodate its traffic.

Portland & Rochester.

This company, at a stockholders' meeting at Portland, on the 13th inst., voted to take $100,000 stock in the Nashua & Rochester road, after a satisfactory lease has been made to the Worcester & Nashua Railroad Company. The directors were ordered to apply to the Legislature for an act to legalize their action.

Boston, Hartford & Erie.

Last week there was only 2¼ miles of track to be laid to complete the section of this railroad between Putnam and Willimantic, Conn. With this completed, the way will be open to run trains from Boston to Hartford, but it is not intended to put passenger trains on this line before spring. When the Connecticut Air Line is completed between Middletown and Willimantic, which will be in about seven months, it, in connection with the New York & New Haven and the Boston, Hartford & Erie, would form the shortest route between New York and Boston, though it may not be possible to make them work together.

Addison County Railroad.

This railroad, which extends from the Rutland Railroad at Whiting, 22 miles north of Rutland, west 13 miles to Lake Champlain, opposite Ticonderoga, is now completed. It is operated by the Vermont Central Company.

Lake George Railroad.

Engineers are making a survey for a railroad from Ticonderoga, N. Y., southwest along the west bank of Lake George to Caldwell, at the foot of the lake. The most formidable obstacle in the way is Hague Mountain.

Shepang Valley.

This railroad, which extends from Hawleyville, Conn., on the Housatonic Railroad 23 miles northwest of Bridgeport, northeast 32¼ miles to Litchfield, was completed December 7.

Rutland & Whitehall.

The marble and slate quarrymen of Rutland, Vt., Hydeville, Fairhaven and vicinity, complain that the rates of freight on their heavy products (which always form a very large part of their cost to the consumer) are unreasonably high on the Rutland & Burlington and Rensselaer & Saratoga railroads, and threaten to construct a narrow-gauge railroad of their own from Rutland southwest to Whitehall, N. Y., about 20 miles. This would connect them with the canals of New York.

Baltimore and New York Freight.

The Baltimore *American* says: "Our commercial men and shippers, who have heretofore during the winter seasons, when the canals are closed by ice, had cause of complaint in the transportation of goods between Baltimore and New York, will be glad to learn that better and cheaper arrangements are to be made for the present season. We learn from good authority that the Pennsylvania Railroad Company (lessees of the Camden & Amboy Railroad) and the Philadelphia, Wilmington & Baltimore Railroad Company have initiated measures which will bring about the extension of unusual facilities to the shippers of heavy and low-class freights between the points named. A representative of the former company is now in our city in consultation with the officers of the Philadelphia, Wilmington & Baltimore Company, and, as there is an agreement of purpose between both corporations, we may anticipate that as soon as the necessary arrangements can be made special rates will be given on the class of freights named during the time that canal navigation is interrupted or uncertain."

St. Louis & Evansville.

A company of this name has commenced survey for a railroad from Duquoin, Ill., the present eastern terminus of the St. Louis, Belleville & Southern Illinois Railroad, eastward toward Evansville. Such a line would be 22 miles south of the St. Louis & Southeastern road at Duquoin, but for most of the distance would be not more than 10 miles from that road.

Green Bay & Lake Pepin.

Surveys have been commenced for an extension of this railroad from New London westward to Grand Rapids, Wis. Track-laying is progressing well between Green Bay and New London. The company hopes to be able to continue it to the Mississippi next season.

Jackson, Lansing & Saginaw.

The Detroit *Tribune* gives the following concerning the land grant of this company, whose road is now completed for about 70 miles north of Wenona:

"The grant of the company expires June, 1873. The sales of the land department the present year amounted to $200,000, at an average price of $7.25 per acre. The greater portion of this is pine land. It is said that the acceptance of the present section gives the company more valuable lands than those acquired heretofore. The gross grant was 580,000 acres, of which the company has already come into possession of 345,000. The grant extends to Otsego County, 72 miles from Wells."

Baltimore & Ohio.

This company has had some disagreement with Wheeling and Ohio County, W. Va., concerning their assessments of its property for taxes, and it now offers to expend not less than $100,000 in the erection of shops, machinery, etc., in Wheeling, if it shall be released from all claims for taxes *for past, present and future*, on the part of Ohio County, the several townships in it, and the city of Wheeling. These shops are to be for construction as well as repairs. This proposition has been accepted by Ohio County. It is supposed that the increase in the population and the prosperity of the place will be greatly advanced by the establishment of these shops, and that the company will be encouraged to make them as extensive as possible because of their freedom from local taxation.

Lake Shore & Michigan Southern.

The Cleveland *Leader* says: "The Lake Shore is busy with its second track; in a few weeks its Northern Division, between this city and Toledo, *via* Sandusky, will be open, and the road for the entire length of Lake Erie will be double tracked. The amount of freight now moved east and west over a single track by the Lake Shore Company is a very marvel of railway management. But the work of the road has outgrown its present capacity, and called for the costly and permanent remedy which the company is now laboring to supply. Let Toledo be patient. The day of freight blockades on the Lake Shore is nearly over."

Wolfeborough Railroad.

The contract for constructing this New Hampshire railroad has been let to Wilson, Trevant & Co., of Portland, Me., and it is to be finished in time for the summer travel. The Eastern Railroad stockholders are to hold a meeting in Portsmouth on the 26th inst., to consider a proposition to lease the road.

Portsmouth, Great Falls & Conway.

This railroad is now completed to Conway Corner, N. H.

Valley Railroad.

Under this name it is proposed to construct a narrow-gauge railroad from Cleveland up the valley of the Cuyahoga through Akron and Canton, O., to Bowerston, on the Pittsburgh, Cincinnati & St. Louis Railway 83 miles west of Pittsburgh. Its chief freight would be coal and iron ore into Cleveland, and it is proposed to construct it with such a grade that a locomotive could haul as many loaded cars to Cleveland as it could empties back.

Cincinnati, Richmond & Fort Wayne.

The last rail was laid on this railroad December 8. From Richmond north to Winchester, 25 miles, it was completed last year. From Winchester to Fort Wayne, 71 miles, it has been constructed since last July. It has a contract for the use of the Cincinnati, Hamilton & Dayton road from Richmond to Cincinnati, and is leased and will be operated by the Grand Rapids & Indiana Railroad Company, which will thus have a complete north and south line from Cincinnati to Mackinaw, which is now completed for 404 miles. By this route the distance from Cincinnati to Fort Wayne will be 166 miles, while by the Fort Wayne, Muncie & Cincinnati it is 175 miles. The latter has made a combination with the Fort Wayne, Jackson & Saginaw and the Jackson, Lansing & Saginaw, which eventually will give another route between Cincinnati and Saginaw.

Chicago & Superior.

This company, recently formed by the consolidation of the Madison & Portage and the Rockford Central roads, has the 39 miles of road in operation, forming the old Madison and Portage road, a considerable amount of grading (still in progress) from Portage northward toward Grand Rapids, Wis., near which it is to form a junction with the Wisconsin Central, and a little grading done on the Rockford Central, between Rockford and Rochelle, Ill.

The intention of the company is to complete a line nearly due north from Mendota, Ill., through Rochelle and Rockford, Ill., Madison and Portage, Wis., to a junction with the Wisconsin Central, which will have a line from this junction north to Lake Superior at Bayfield. From Mendota to Grand Rapids is about 250 miles. The company expects to have a connection to Chicago from Rochelle, Ill., through the Chicago & Iowa and the Chicago, Burlington & Quincy roads, to Cairo and the South through the Illinois Central, and to Lake Superior and the Northern Pacific through the Wisconsin Central. Concerning the preparations for the construction of the road the Madison (Wis.) *State Journal* says:

"Contracts have been made with experienced and responsible parties for the construction and completion of the road from the State line to Madison, and from Portage to the point of intersection with the Wisconsin Central, near Grand Rapids. The contract provides for the engineering, procuring the right of way, grading, tieing, putting on the iron and ballasting the road, and for the construction of stations, side-tracks, switches, etc., etc.—in short, for furnishing a completed road, ready for the rolling-stock; and it is expected this work will be all completed during the next year. A contract of like character has also been made for the construction of that part of the road from the State line south, through Illinois, to Mendota. So that within the next year the company expects to have the road completed from Mendota to Grand Rapids, at least."

The directors of the new company are: James Campbell, R. B. Sanderson, H. T. Moore, Winslow Bullen, O. D. Peck and David Atwood, of Wisconsin; and Robert P. Lane, George Youngs and Ralph Emerson, of Illinois. President, James Campbell; Vice-President, Robert P. Lane; Secretary, Alden S. Sanborn; Treasurer, J. B. Bowen.

Sioux City & Pacific.

This company will pay a semi-annual dividend of 2 per cent. January 15, at the office of the President, Morris K. Jesup, No. 59 Liberty street, New York.

Creston, Bedford & St. Joseph.

This is the name of the new railroad which is to connect the Burlington & Missouri River Railroad at Creston, Iowa, by a route about 40 miles to the southwest, with Hopkins, on the Missouri line, the northern terminus of the Maryville Branch of the Kansas City, St. Joseph & Council Bluffs road. A train ran through from Creston to Bedford, which is within eight or ten miles of Hopkins, on the 7th inst.

Quincy, Alton & St. Louis.

This company brought suit to compel the Board of Supervisors of Adams County, Ill. (in which Quincy is situated), to pay $18,000 in bonds subscribed to that company by the county. The plea in defense was that the company had not complied with the conditions on which the bonds were subscribed, and this the court held to be the case. An appeal was taken to the Supreme Court.

St. Paul & Chicago.

This company's bridge over the Mississippi at Hastings was completed and tested on the 9th inst., and trains can now run through between Winona and St. Paul. The American Bridge Company of Chicago built the bridge.

St. Louis & Southeastern.

The following are the stations on the part of this railroad completed this year, from Mount Vernon, Ill., to Evansville, Ind., with their distances from St. Louis:

Mt. Vernon, Ill.	75.8	Carmi	122.8
Opdyke	83.5	Hawthorn	126.7
Belle Rive	86.7	Wabash Station	130.8
Dahlgren	90.5	Upton	136.3
Delafield	96.4	Mt. Vernon, Ind.	141.6
Shawneetown Junction	100.0	Stockford	146.0
Thackeray	106.0	Belknap	154.2
Enfield Junction	112.2	Evansville	160.7
Enfield	113.2	Evansville & Crawfordsville Junction	162.2
Trumbull	118.6		

The Shawneetown Division is also completed, and has regular trains running on it. The stations and distances from St. Louis on this branch are as follows:

Shawneetown Junction	100.1	Eldorado	121.8
McLeansboro	101.3	Equality	129.4
Roche Blave	106.2	Cypress Junction	135.5
Rectorville	114.6	Shawneetown	141.5

The company has thus 202.6 miles of road in operation, 171 miles of which is in Illinois, and it gives St. Louis and Evansville intimate connections with a very large part of Southern Illinois.

There are trains enough on this new road to do a considerable business. There is one express and one passenger train between St. Louis and Evansville, the former making the distance of 162 miles in about 7½ hours. There is also a "Cairo express" running over the 60 miles between St. Louis and Ashley and connecting at the latter place with the Illinois Central for Cairo, a "Mascoutah accommodation" between St. Louis and Mascoutah, 25 miles, and a "Belleville accommodation," between St. Louis and Belleville, 14½ miles. There is a local freight and an express freight between St. Louis and Evansville, and a coal train between St. Louis and Mascoutah. On the Shawneetown Division there is a mixed train connecting with the mail to and from Evansville, and an accommodation train between Shawneetown and Equality.

Atlantic & Pacific.

The St. Louis *Republican* of the 16th says:

"Mr. S. F. Hodges, one of the engineers of the Atlantic & Pacific Railroad, reached here on Thursday last, after eighteen months' service on the contemplated line of the above road, principally in Arizona. He started from Seneca, in the Indian Territory, one year ago July last, to make the preliminary survey to the Rio Colorado Ciquito, on or near the thirty-fifth parallel. Maj. Lawrence made the preliminary survey from there to Big Colorado, on the western border of Arizona. Mr. W. Robinson, Division Engineer, finished the survey of the line from there to San Francisco. Maj. E. G. Rehrer, who was appointed Division Engineer in July last, had the superintendency of the surveys from the Rio Grande to Big Colorado, and Mr. J. F. McCabe revised the surveys of a portion of the line from Albuquerque to Fort Bascom last fall. Most of the entire route surveyed has been revised and is as follows:

"From St. Louis to Vinita, 364 miles, and on the Creek lands in the Indian Territory, the road being due southwest; then it bears westwardly near the thirty-fifth parallel, and much of the way along the beautiful valley of the Canadian River on the Bernardino meridian in Southern California, thence northward to San Francisco and south to San Diego. The entire distance from here to San Francisco by this route will not fall short of 3,000 miles, and to San Diego about 2,750 miles. The road will cross the Arkansas near the mouth of the Red Fork of that stream, thence up the Canadian, reaching the Rio Grande about 20 miles south of Albuquerque, thence on or near new Fort Wingate, striking the Little Colorado near the mouth of the Rio Puerco. From there it will take the divide between the San Juan and Rio Gila. It will cross the Rio Colorado near Fort Mohave, thence west to the summit of the Sierra Nevada, and from there northnorthwest to San Francisco.

"The country through which it will pass is admirably adapted to the construction of a first-class railroad, and at a moderate expense. Nearly the entire route abounds in mineral resources and is also unsurpassed in agricultural wealth. The climate is most salubrious, and but little danger need be ever apprehended by snow blockades on this route.

"The Indians object to the agent of the company living in the Territory, it being contrary to their laws, but this matter will probably be adjusted in a short time. The road at present is completed about 366 miles from St. Louis, or about two miles beyond Vinita. Work is being pushed ahead."

St. Louis, Lawrence & Denver.

An officer of this road, the completion of which on the 2d inst. we have chronicled heretofore, gives us the following information concerning it: The grading of the road, which is 61 miles long, was commenced last February. The means for its construction was supplied by the counties and towns on the line, which subscribed $645,000 in their bonds for that purpose. The lease to the Missouri Pacific is for 30 years, and it is to run cars through between St. Louis and Lawrence and charge no more for fares and freights than between St. Louis and Kansas City.

Tuskegee Railroad.

This Alabama railroad (narrow gauge) has recently been completed under the direction of Mr. E. M. Grant, of Macon, Ga., a well-known Southern engineer who is giving especial attention to the construction of narrow-gauge railroads. It has been working more than a month, and, Mr. Grant informs us, "everything about it works admirably."

Montpelier & Wells River.

The directors make an urgent appeal to the stockholders to pay up their assessments. If they respond promptly, the grading and masonry for the entire line will be completed by May, and the road be in full operation next year. No mortgage has yet been put on the road.

Woonasquatucket Railroad.

The Providence *Journal* says that the subscriptions to the stock of the railroad with this agreeable name will be made so speedily and to such amount that the work will be commenced at an early day. This road is to run northwesterly from Providence to Pascoag, R. I. An extension of six miles will carry it to East Thompson, Ct., from which place to Southbridge a branch of the Boston, Hartford & Erie Railroad is now running. The building of the Palmer & Southbridge road would then complete an important through line from Providence to Palmer, Springfield, Albany and the West.

A Second Buffalo Bridge.

The Buffalo *Express* reports that the Great Western Railway Company is not likely to agree with the Grand Trunk for the use of the International Bridge over the Niagara at Buffalo; but contemplates extending the Loop Line to Niagara River at Black Creek, and there making an independent crossing of the river by bridges from the Canadian shore to Grand Island, from Grand Island to Tonawanda Island, and from Tonawanda Island to the eastern bank of the river at Tonawanda, several miles north of Buffalo, where connection can be made with both the Erie and the New York Central roads. It is understood that engineers are now engaged in making surveys for carrying the proposed road across Grand Island, which is some six miles in width at the point indicated.

New Jersey Central.

This company has recently completed a line from Elizabethport station, on the main line, to Brill's Farm, on the Newark & New York Railroad. This line gives the company substantially two approaches to New York from Newark and Elizabethport, and two routes across Newark Bay, so that all trains may make their way across by one route, should the bridges on the other be out of repair. Moreover, this short line gives the main line an approach to Jersey City over the Newark & New York Railroad, which is probably the best line for high speeds in America, having no crossings at grade, and by it all fast trains can be sent through in the shortest possible time.

The line to South Amboy which this company is constructing, and which will form a section of a line to Long Branch, will be virtually an extension southward of their new line.

Philadelphia & Reading.

This company will pay its customary semi-annual dividend of 5 per cent., in Philadelphia, January 15. Transfers were closed December 20.

Kentucky & Great Eastern.

Lewis County, Ky., voted, December 2, to subscribe $100 000 to this company by a majority of 132. Boyd and Greenup counties have so far refused to order a vote on propositions to subscribe. The company, however, has ordered a survey to be made for the line.

Lehigh Valley.

This company has completed the extension of its Penn Haven & Hazelton Branch west to Deringer Central Coal Works, eight miles west of Hazelton, where it connects with the new Danville, Hazelton & Wilkesbarre Railroad. In connection with this the distance from Hazelton to Sunbury, Pa., is 51 miles, from Easton to Sunbury 121 miles, and from New York to Sunbury 196 miles.

Detroit and Bay City.

The Detroit *Tribune* announces that the contract for the construction of this railroad was let on the 13th inst. to H. H. Smith, who was the chief contractor on the Detroit, Lansing & Lake Michigan road. It is intended to complete the line within two years, if the people on the line make the expected subscriptions. This line will divide the territory between the Detroit and Port Huron line of the Grand Trunk and the Detroit & Milwaukee Railroad, and when it is completed Detroit will have four lines extending into the interior of Michigan north of the Michigan Central road. There are few large towns on the proposed route, and the country is not very thickly settled; but it will give the shortest possible route between Detroit and the Saginaw Valley, where are several of the most considerable towns and prosperous industries of the State. If, as has been intimated, it is to be controlled by parties who are in close connection with the Michigan Central and the Jackson, Lansing & Saginaw roads, it may be made the eastern outlet for that part of the latter road between Saginaw and Mackinac, for which it would be much more favorable than the indirect route by way of Jackson. The latter is well situated for the Southern and Western business, but not for the Eastern.

Michigan Air Line.

One of the officers of this company, whose road between Jackson and Niles, Mich., is leased permanently to and operated by the Michigan Central Company, informs us that his company is now ballasting and expects soon to iron a section of their original line, partly graded some time ago, from Romeo southwestward to Rochester, in Oakland County, Mich. The company has long had in operation a short line from Romeo east to Ridgeway, on the Port Huron & Detroit Branch of the Grand Trunk, 16 miles long, which the extension to Rochester would make 10 miles longer. Next season the company expects to extend this section still further southwest from Rochester to Pontiac, 10 miles, or to a junction with the Detroit & Milwaukee road near that place, and at the same time to complete a section from Jackson eastward as far as the Detroit, Lansing & Lake Michigan road (40 miles), if not entirely through. An extension from Ridgeway east to St. Clair is also determined upon, and this will give a connection with the Canada Southern.

Grand Rapids & Saginaw.

The required subscriptions for this proposed Michigan railroad have been secured from all points along the line except for the 22 miles between Plumb's Mills, four miles north of Grand Rapids, and Patterson's Mills, where $46,000 more is wanted.

Grand Rapids & Newaygo.

The contract for laying iron, constructing stations and other buildings, and supplying rolling stock for this road, has been taken by Chester Warren, of Chicago.

Saginaw Valley & St. Louis.

Seven miles of this line is graded, ten miles cleared, and a small force is now at work on it.

Flint & Pere Marquette.

George H. Briggs has the contract for the grading, ties, bridges and culverts of ten miles of this road, eastward from its western terminus on Lake Michigan at Ludington.

Grand Rapids & Holland.

The Muskegon (Mich.) *Chronicle* says that Culbert Bros. have completed on this road in less than three months, 23 bridges, 24 cattle guards, and nine long culverts. The last bridge, 480 fee long, was built in eight days, the timber standing in the woods on the morning of the first day.

Marshall & Coldwater.

A large part of the grading on this road is completed, and between the towns named the road-bed is to be ready for the iron in the spring, and an effort will be made to complete it before the close of next season to the Detroit & Milwaukee Railroad at Muir. Subscriptions of stock have been made to secure its extension still further north to Elm Hall, in Gratiot county, which is 110 miles north of Coldwater. An effort will be made to secure sufficient subscriptions to warrant the extension from Elm Hall north to a junction with the Flint & Pere Marquette Railroad.

Painesville & Youngstown.

Iron is down and trains running on the first division of this new narrow-gauge road from Painesville to Chardon, O., 12 miles. The third division, from Youngstown to Warren, is located and nearly ready for the grading. The second (middle) division is partly located.

Port Huron & Lake Michigan.

The formal opening of this railroad from Port Huron to Flint, Mich., was celebrated by an excursion on the 12th inst. The stations on the road as far as completed, with the number of miles from Port Huron, are as follows: Thornton, 10; Emmet, 19; Capac, 27; Imlay City, 34; Attica, 39; Lapeer, 47; Elba, 53; Davison, 57; Flint 66.

International Railroad.

Mr. H. M. Hoxie, General Superintendent of this road, under date of December 1 announced that on the 11th inst. 50 miles of this important Texas railroad, from Hearne, on the Houston & Texas Central road, 120 miles north of Houston, northeast to Jouitt, were to be opened for business. The stations and their distances from Hearne are: Englewood, 15 miles; Lake, 24 miles; Marquez, 36 miles; and Jouitt, 50 miles. Passenger and freight trains are run daily, in connection with the Houston & Texas Central. By the 1st of February it is expected to reach the Trinity river. One of the officers informed us that on the 7th inst. the Commissioners on the part of the State made a critical examination of the 50 miles completed. The road-bed was in excellent condition, the iron and fastenings of the best quality and most approved patterns. The bridges are of the Post pattern, and built by the American Bridge Company, of Chicago. A speed of 54 miles per hour was made on the line.

Washington & St. Louis.

The Ohio & Mississippi Railroad Company announces that it has completed arrangements with the Baltimore & Ohio Railroad for a permanent daily line of through Pullman palace sleeping and parlor cars to run between St. Louis and Washington City without change. The first car of the line left on Monday, at 6:45 a.m., 11th inst.

Chicago & Columbus.

A corporation has been organized in Indiana which hopes to secure the aid of the Baltimore & Ohio for a line connecting its Central Ohio Division from Columbus, Ohio, through Celina, Ohio and Bluffton, Ind., to Chicago. This, however, would have no connection with Pittsburgh, which the Baltimore & Ohio desires its Chicago line to have.

Atlantic & Pacific.

From a long article to the St. Louis *Republican*, describing the newer part of this road and the recent excursion of the Government commissioners to examine and report upon the 50 miles completed this year between Neosho, Mo., and Vinita, Indian Territory, we select the following description of the new section, by the completion of which the company is entitled to a considerable grant of lands:

"From Neosho the inspection of the newly completed division commenced. The commissioners took a position at the end of the rear car, and on reaching a bridge or other structure a stoppage took place for a critical examination. The track followed down the valley of Lost Creek into the Nation.

"Seneca is passed on the right, and is the last town passed in Missouri, it being on the Indian frontier.

"From the State line the party passed through the country occupied by the Wyandottes and Senecas as far as the Grand River. The tribes mentioned own 160,000 acres and number about 200 The other small tribes holding separate territories this side the Grand River are the Shawnees, Peorias, Quiapaws, etc. The major portion of the Delawares are identified with the Cherokees. A large tract of land, after passing the first farm, belongs to Audrain, a Frenchman.

"The bridge over the Grand River crosses just below the junction of the Grand, the Neosho and Lost Creek. Some time was spent here in examining this fine structure. The patent is "Post's iron combination." The bridge is 650 feet long, having four spans each 158 feet in length. The piers are of the firmest kind, constructed with stone ferried down on flatboats from a quarry a short distance above, and rise 35 feet above the water. The width of the bridge is 18 feet. The cost was about $60,000. It was built from the foundations in less than sixty days. The workmanship doubtless complies with every requirement of the law.

"The Cherokee Nation is entered on the other side at Prairie City. The improvements were made by George Rogers, but he being an adherent of Col. Boudinot, the Cherokees have denied his right to citizenship. His nativity is not disputed, as he is a son of old John Rogers, a celebrated chief of the Cherokees.

"Samuel Stanton, the Stock Agent of the railroad company, presented himself here. Some very capacious stock yards have been erected near this point under his supervision, as this is the great center of the cattle transportation.

"Near here the old Texas trail passes from Fort Scott to Gibson, and runs thence to San Antonio. It was laid out as a military road some fifty years ago, and has since become the great cattle trail. It passes four miles west of Prairie City. Mr. Stanton has made arrangements for loading 2,000 head a day with ten men. In the Prairie City stock yards there are 45 chutes, and yard accommodations for five thousand head of cattle. About ten thousand head were shipped east from here in October. One day the agent loaded seven trains a day, being an average of 250 head to a train.

"The next Indian station is 'Oscuma Meonnry' 'good water.' Close by is a fine white sulphur spring yielding largely a strong, clear, cold fluid. The next station, six miles west is called Afton, and then Albia, when we arrive at Vinita, 364 miles from St. Louis, passing it at the rate of twenty miles an hour to the end of the track, two miles beyond. Colonel Boudinot owns two thousand acres of land around the depot, having made the first improvements, which, according to the Cherokee laws, entitles him to hold possession, before the Missouri, Kansas & Texas Railroad Company laid down their track. By permission of Colonel B. a stone store has been built by Johnson Thomson, a Cherokee, and another native named Trott is putting up a livery stable.

"The misunderstanding still exists in all its vigor between the two roads, the Missouri, Kansas & Texas trains refusing to stop at Vinita and let off passengers and freight destined for the Atlantic & Pacific road. But the law requires them to come to a full stop within one thousand feet from a station before passing it, and passengers are swift to avail themselves of the opportunity.

"There yet remain about 1,700 miles of road to be completed to San Francisco. The surveying parties under Jacob Blickensderfer, Engineer-in-Chief, will complete their work in December, so as to file the report in the Interior Department by the middle of the month. Leaving Vinita, the route crosses the Red fork of the Arkansas, and follows up to the mouth of Kingfisher Creek, thence crosses to the Canadian, and following up that stream to Fort Bascom, a place west of the Staked Plains, having crossed its northern limit. The route goes near Anton, Chico, on the Pecos River, a tributary of the Rio Grande, in New Mexico. This is quite a Mexican settlement of 1,000 people, about 750 miles from the State line. The next point reached will be at or near Albuquerque, 100 miles further west, crossing the valley there, thence west to the valley of the Puerco, which is followed to its junction with the Little Colorado; across Campbell's Pass, then leaving the Little Colorado at Sunset Pass, crossing the Little Colorado; passes the San Francisco mountains on the south; then to the Big Colorado, crosses at Fort Mogave, near the Needles on the west boundary of Arizona. The route then passes west through the basins in California to the Sierra Nevada, across the Solidad Pass, and then, striking the Pacific either at Angelos or Buenavataro, follows up between the Coast Range and the ocean to San Francisco.

"Of the features of this great route it is said that the Canadian for 250 miles is a fine agricultural region and well timbered. At the head of the Pecos and the foot of the Ratoon Mountains, coal mines are found. The valley of the Pecos is settled by 'greasers,' it being a fine agricultural country. The country further west consists of agricultural valleys and abounds in minerals. At some point on the Rio Grande a junction will be made with the narrow-gauge railroad coming down from Denver, now built seventy-five miles.

"Where the main road of the Atlantic & Pacific strikes the Canadian, it will meet the Brong road or Prong, coming up from Fort Smith, having a length of 300 miles. It is required in the charter of the Atlantic & Pacific to build this branch. Four parties are out surveying that route. The surveys will be finished during the month. A railroad coming from the east is finished from Little Rock to Fort Smith, which will connect with the line to the Pacific, keeping up the Arkansas to the Canadian, then up that stream to the intersection with the main trunk from St. Louis.

"The land sales of the Atlantic & Pacific road amount to from $500,000 to $600 000 annually. The company have alternate sections, extending ten miles on each side of the track in the State, and twenty miles each side in the Territory. The Government agreed to extinguish the title of the Cherokees to these lands. Whenever the Government settles this Indian question, then the road is entitled to these lands. The Government can either make a purchase of these lands from the Indians, or pass the bill through Congress giving each 160 acres of land, and purchase the balance at a nominal price, and with the proceeds create a fund for education—as advocated by Boudinot.

"The railroad officials say that the intelligent people of the Territory favor this plan. The railroad company have now 1,400,000 acres in Missouri, distributed from Phelps County west, through Pulaski, Webster, Greene, Lawrence, Newton and Jasper counties. These lands are held for sale at from $2 to $15 per acre. They embrace some of the richest lands in the State. Considerable emigration is flowing in, principally from the Northern States."

Bauschinger's Indicator Experiments on Locomotives.

(Continued from page 336.)

3. *The Absolute Performance of Steam and Fuel.*

The relative efficiency, or economical value, of a steam engine as a power-producer is proportionate to the amount of fuel required while performing a certain duty, and this amount is dependent, in its turn, upon three elements: 1. The evaporative efficiency of the boiler and of the fuel employed, as expressed by the quantity of water evaporated per pound of fuel consumed. 2. The absolute performance of the steam in the cylinders, that is to say, the steam or water consumed per indicated horse power per hour. 3. The useful effect given off by the engine as compared with the absolute or total performance of the steam. The consumption of fuel per effective horse power per hour can easily be ascertained by measuring, on the one hand, the quantity of fuel burned, and by employing, on the other hand, an appropriate dynamometer, recording the useful work developed during a certain period; while, in order to define accurately the other elements, above enumerated, the water evaporated, together with the absolute performance of the steam, as shown by the steam diagrams, should be measured at the same time.

Although the experiments under notice are not specially suited to investigate fully all these points, yet the mode of conducting the experiments, as explained by us on page 218 of the present volume, was such as to afford, nevertheless, some valuable information as regards the absolute duty performed by the steam during each trial run, the evaporative capacity of the boilers, and the consumption of water and fuel per indicated horse power per hour. It is to be regretted, however, that an efficient traction dynamometer was not employed by the experimenters, so that the useful effect given out by each engine might have been obtained.

For the special purpose of comparing the relative values of two different systems of valve motions, and in order to ascertain the effect of various modifications of one and the same system of steam distribution, it is an essential condition that the properties of the engines as steam users should be treated as distinct from those of the various boilers as steam producers; hence the quantity of water used per indicated horse power per hour is the real coefficient of efficiency, as being independent of the evaporative capacity of the boiler, and of the internal resistances of the engine proper. On the other hand, it should be remembered that the coefficient expressing the quantity of water used is influenced, to a greater or lesser amount, by the water which is carried along in a globular state with the steam, and in the case of locomotive engines, especially, this quantity of water thus mechanically carried through with the steam bears a considerable proportion of the whole amount of water consumed. The loss occasioned by moist steam in this manner was not accurately measured by Professor Bauschinger, but every precaution was taken (by observing the normal water level and boiler pressure), to obtain a supply of steam in an equally dry state during the various runs. If this equality of condition was really obtained, the records of the quantities of water used per indicated horse power per hour will serve the purpose of comparing the efficiency of the different valve motions much better than the corresponding amount of fuel burned, which latter element depends, as we have stated, both upon the capabilities of the boilers as steam producers and upon the evaporative efficiency of the fuel consumed.

The limited space of necessity allotted for this series of articles prevents us from reproducing, *in extenso*, the detailed observations made by the experimenters with each engine and during each succeeding period of the trial runs. We publish, however, herewith, a table (No. VII.) recording the general results obtained by Professor Bauschinger, and Locomotive Superintendent Zorn of Augsburg. This table contains 30 columns, which have been worked out in the following manner: The first column refers to the different classes of engines experimented upon, and of which we have given the leading dimensions in table No. 1, page 218 of the present volume; columns 2 and 3 give the lengths of the various trips and the total rise or fall in feet between the different stations, while the times, gross and net, occupied on trip, are given in the next two columns. The following columns, 6, 7 and 8, have reference to the nature of the experimental trains and the state of the weather. Columns 9 to 13 contain data as regards the mean velocity of the different engines, the boiler pressure and degree of expansion; the total amount of work done on the various trips is given in columns 14 and 15, the former containing the total number of foot-pounds of work developed during trial as computed in the following way: In the first place, the mean effective cylinder pressure, shown by the indicator, under a certain boiler pressure, was reduced to the average pressure indicated by the boiler steam gauge during a certain period, the entire trip being subdivided into a number of such periods, according to the position of the regulator, the reversing lever, and blast pipe orifice. For instance, supposing the mean effective pressure to be 65 pounds, the corresponding boiler pressure 100 pounds, and the average boiler pressure for the period 114 pounds, then reduced effective pressure $= \frac{65 \times 114}{100} = 74$ pounds, this figure, multiplied by the number of revolutions made by the driving wheel during the period, gives the corresponding amount of work done, and the results thus obtained for all the periods of the whole trip added together and then multiplied by the constant factor 4 × piston area × stroke represent the total number of foot-pounds of work developed during the entire run. The figures in column 15, which have been derived from the preceding column and from the fifth, express the performance of the engines in horse powers of 33,000 pounds per minute. Column 16 refers to the nature and to the quality of the fuel consumed, but we have no very precise information as regards the evaporative efficiency of the different fuels used. The weight of the peat per cubic foot is given, however; the coals employed were of the average quality as found in Saxony. Columns 17 to 20 give figures relating to fuel and water consumption; the total quantity of fuel burned, as given in column 17, refers, in some cases, to a double journey, as at some of the stations the fuel could not be conveniently weighed, and in the case of engine (D) this was entirely neglected. The principal results for comparison of engine efficiency are given in columns 18 and 20, viz., the consumption of fuel and water per indicated horse power per hour. Columns 21 to 25 contain data which will find their explanation in our next article, treating especially on water and steam consumption. In the next four columns, 26 to 29, we have given the consumption of fuel and water both per square foot of fire-grate area per hour and per square foot of heating surface per hour. Finally, column 30 of the table shows the quantity of water evaporated per pound of fuel consumed.

Referring to the table, it will be noticed that the quantity of water used per indicated horse power per hour varies greatly; in fact, a comparison of the figures in column 20 with those in column 15 will show that the steam is being more efficiently utilized as the amount of work developed by the engine increases. This may at first sight appear difficult to explain, but it should be remembered that in most cases where engines are employed on work demanding a comparatively small exertion of tractive power, steam is cut off short: the cylinders are, therefore, cooler and the condensation of steam will consequently be greater, particularly in the case of unjacketed outside cylinders. If we take, as an example, the third and fourth trip performed with engine A, we shall find in column 15 that the duty performed was equal to 244 and 140 horse powers respectively; the water used was, in the former case, 27.94 lb. per indicated horse power per hour, and in the latter case 35.31 lb., while the quantity of fuel burned per indicated horse power per hour, as recorded in column 18, was about the same on both trips. This marked discrepancy between the fuel burned on the one hand and the water evaporated on the other hand, is owing to the varying evaporative capacity of the boiler on the two runs; thus, when the engine was on the fourth run, or on the down journey, the consumption of fuel per square foot of heating surface per hour was scarcely one-half of that consumed on the third run, or on the up journey, and the water evaporated per pound of fuel burned was consequently much more in the former case; in other words, while the evaporative capacity of the boiler was more favorable on the down journey, the performance of the steam in the cylinders was impaired in almost the same proportion, but both are compensated in the consumption of fuel per horse power per hour. This consideration confirms our former statement, namely, that for the purpose of rating the relative efficiency of an engine, a distinction should be drawn between the performance of the steam in the cylinders and the capacity of the boiler as a steam producer.

A further comparison of the figures contained in column twenty for the various engines will establish the interesting fact, that the water used per indicated horse power per hour was decidedly less in the engines fitted with the ordinary shifting link motion, than in those engines with the Meyer double valve gear. The result was to be anticipated from our investigation in a preceding article, treating on the form of the indicator curves; nor will it be a matter of surprise that engines A and B, fitted with Allen's or Trick's double admission valve, should show a better performance of the steam in the cylinders than the other engines supplied with the usual slide valve.—*Engineering.*

[TO BE CONTINUED.]

TABLE VII. SHOWING THE RESULTS OF EXPERIMENTS MADE BY PROF. BAUSCHINGER AND HERR ZORN, LOC. SUPT., AUGSBURG.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Class of Engine	Extension of Trip.		Time occupied on trip.		Nature of Work.			Mean speed of engine.		Mean boiler pressure in pounds per square inch.	Mean period of admission.		Work done.	
	Names of stations between which the trips were made.	Distance between stations.	Total rise or fall in feet.	Including all stoppages.	Actual running time.	Class of train.	Composition of train.	Meteorological observations.	Number of revolutions of driving wheels per minute.	Mean velocity of piston in feet per second.		Distance traveled by piston during admission = length of stroke.	Actual admission, including clearance spaces.	Total number of foot-pounds of work developed during trial.	Mean indicated horse power developed during trial.
		Miles	ft.	h. m.	h. m.							p. ct.	p. ct.	foot pounds	IHP
A	Augsburg—Munich	39.2	+ 106	3.6	2.16	goods	43 wagons	fine, no wind	79	5.3	110	22	26	931,000,000	222
	Munich—Augsburg	39.2	— 106	2.44	1.49	"	34 "	"	101	6.7	162	26	30	615,000,000	185
	Augsburg—Guenzach	52.8	+ 1069	4.7	3.3	goods (2 engines)	40 "	fine, very warm	84	5.6	110	34	36	1,376,000,000	244
	Guenzach—Augsburg	52.8	—1069	2.54	1.46	passeng'r (2 engines)	16 carriages	cold wind against train	125	8.3	83	20	24	459,000,000	140
B	Augsburg—Kempten	64.8	+ 704	2.33	2.2	express	7 "	fine and warm	147	9.8	101	29	33	812,000,000	216
	Kempten—Augsburg	64.8	— 704	2.27	1.52	"	6 "	"	157	10.5	89	23	27	441,000,000	128
	Augsburg—Lockhu's'n	31.2	+ 86	2.19	1.45	goods	41 wagons	cold, no wind	91	5.4	110	33	37	627,000,000	194
C	Nuernberg—Bamberg	37.6	— 237	1.24	1.0	express	7 carriages	stormy and rain	179	10.4	87	49	52	448,600,000	214
	Bamb'rg—Neuenmarkt	47.0	+ 369	1.54	1.28	express (2 engines)	7 "	"	158	9.7	88	44	47	491,000,000	186
	Neuenmarkt—Bamb'rg	47.0	— 369	1.44	1.16	express	6 "	fine, cold	190	11.0	90	37	40	344,000,000	147
	Bamberg—Nuernberg	37.6	+ 237	1.25	1.9	"	6 "	cold side wind	169	10.3	97	40	43	370,000,000	174
D	Fuerth—Kitzingen	45.1	— 152	3.46	1.25	goods	30 wagons	fine, warm	115	8.3	102	25	30	751,000,000	286
	Kitzingen—Wuerzburg	14.1	— 82	1.7	0.27	"	"	"	94	6.8	103	29	34	275,000,000	330
	Wuerzburg—Bibart	30.5	+ 440	2.44	1.14	"	"	"	121	8.7	101	27	32	707,000,000	310
E	Augsburg—Kempten	64.8	+ 704	2.38	2.7	express	5 carriages	strong wind	136	8.3	71	20	25	596,000,000	152
	Augsburg—Kempten	64.8	+ 704	2.35	1.55	"	6 "	fine	145	8.9	77	20	25	583,000,000	164
	Kempten—Augsburg	64.8	— 704	2.26	1.38	"	7 "	"	148	9.0	75	16	20	379,000,000	125
F	Nuernberg—Pleinfeld	27.2	+ 289	2.21	.....	goods (2 engines)	53 wagons	rain, cold	94	5.2	77	40	44	261,000,000	94
	Nuernberg—Bamberg	37.6	— 237	1.26	.....	passenger	7 carriages	fine, cold	161	9.0	73	33	37	256,000,000	117
	Bamberg—Nuernberg	37.6	+ 237	1.30	.....	"	6 "	"	152	8.4	76	39	43	301,000,000	129
G	Bamberg—Lichtenfels	20.2	+ 77	1.13	0.59	goods	40 wagons	fine, warm	103	7.2	100	42	45	319,000,000	170
	Lichtenfels—Neuenm't	26.7	+ 292	2.42	1.27	"	"	"	101	6.7	97	49	52	326,000,000	233
	Neuenmarkt—Licht'la	26.7	— 292	2.20	1.17	"	50 "	"	99	6.6	100	39	42	314,000,000	131
H	Stockheim—Hochst'dt	15.5	— 240	1.13	0.40	mixed	18 wagons	snow	101	6.7	74	24	30	167,000,000	135
	Hochstadt—Stockh'm	15.5	+ 240	1.18	0.54	"	11 wagons	cold	99	6.6	71	42	47	267,000,000	160
	Stockheim—Hochst'dt	15.5	— 240	1.11	0.36	"	11 wagons	snow and rain	110	7.3	69	40	53	157,000,000	141

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Extension of Trip.	Consumption of fuel.		Consumption of water.		Consumption of Steam.					Consumption of stores per square foot per hour.				Water evaporated per pound of fuel consumed.
Class of Engine. Names of stations between which the trips were made. Description of fuel consumed.	Total quantity of fuel consumed.	Fuel consumed per indicated horse power per hour.	Total quantity of water evaporated.	Quantity of water used per indicated horse power per hour.	Calculated from contents at beginning of expansion—contents at beginning of compression.	Compared with Column 19. (Contents of water).	Calculated from contents at beginning of release—contents at beginning of compression.	Compared with Column 19. (Contents of water).	Difference between Columns 22 and 24.	Fuel consumed per square foot of fire-grate per hour.	Fuel consumed per square foot of heating surface per hour.	Water evaporated per square foot of fire-grate per hour.	Water evaporated per square foot of heating surface per hour.	Water evaporated per pound of fuel consumed.
	lb.	lb.	lb.	lb.	lb.	p. ct.	lb.	p. ct.	p. ct.	lb.	lb.	lb.	lb.	lb.
A	Augsburg—Munich, peat of 18 lb. per cubic foot.	8,190	9.7	15,854	31.4	8,937	44	12,067	24	20	109.8	1.36	348.0	4.4	3.2
	Munich—Augsburg, peat of 18 lb. per cubic foot.			10,387	31.2	4,972	52	8,004	23	29					
	Augsburg—Guenzach	5,025	7.0	29,774	27.9	12,441	40	17,767	14.5	25.5	97.8	1.23	387.0	4.95	4.0
	Guenzach—Augsburg, peat of 9.5 lb. per cubic foot.	1,662	6.7	8,747	35.3	2,621	70	6,168	29	41	44.6	0.56	232.1	2.97	5.32
B	Augsburg—Kempten, peat of 16.7 lb. per cubic foot.	3,567	8.0	11,480	26.1	6,740	40	9,997	21	19	105.2	1.33	348.5	4.4	3.3
	Kempten—Augsburg, peat of 16.7 lb. per cubic foot.	2,004	8.3	6,943	29.1	3,405	51	5,707	18	33	64.46	0.73	277.8	2.75	3.5
	Augsburg—Lockhausen, peat of 16.7 lb. per cubic foot.	2,922	8.6	9,840	29.0	5,706	42	7,791	21	21	96.86	1.23	326.7	4.18	3.4
C	Nuernberg—Bamberg, coals	2,750	5.5	7,281	30.4	5,507	25	6,390	15	10	92.4	1.22	324.7	6.93	6.27
	Bamberg—Neuenmarkt, coals			8,200	61.5	5,486	33	6,418	22	11					
	Neuenmarkt—Bamberg, coals	.....	...	6,287	33.7	3,770	40	4,590	27	13	.....	.....	.....	.....	.....
	Bamberg—Neurnberg, coals	.....	....	6,122	30.5	3,861	37	4,744	23	14	.....	.....	.....	.....	.....
D	Feurth—Kitzingen, coals	.....	....	13,429	32.5	5,445	59	8,659	34	25	.....	.....	.....	.....	.....
	Kitzingen—Wuerzburg, coals	.....	....	4,646	31.2	2,161	53	3,714	31	22	.....	.....	.....	.....	.....
	Wuerzburg—Bibart, coals	.....	....	12,629	33.0	5,513	56	8,192	35	21	.....	.....	.....	.....	.....
E	Augsburg—Kempten, peat of 14 lb. per cubic foot.	3,514	11.0	11,480	35.6	6,784	41	11,032	3.5	37.5	120.4	1.62	339.4	5.91	3.3
	Augsburg—Kempten, peat of 14 lb. per cubic foot.	2,898	9.2	10,551	33.4	6,687	37	9,900	6	31	100.4	1.50	368.2	5.61	3.6
	Kempten—Augsburg, peat of 14 lb. per cubic foot.	2,156	10.5	6,943	33.8	4,155	40	6 870	1	39	79.8	1.21	255.2	3.85	3.2
F	Nuernberg—Pleinfeld, coals	.....	....	5,430	40.0	3,801	33	4,100	27	6	.....	.....	.....	.....	.....
	Nuernberg—Bamberg, coals			4,646	33.5	3,733	20	4,709	0	20					
	Bamberg—Nuernberg, coals	2,200	7.0	6,068	37.2	4,600	24	5,464	10	14	79.2	1.46	385.0	7.26	5.39
G	Bamberg—Lichtenfels, coals			5,740	34.3	4,438	23	5,462	5	18					
	Lichtenfels—Neuenmarkt, coals	5,000	7.5	12,846	37.9	9,336	27	10,406	19	8	59.4	0.92	310.2	4.73	5.72
	Neuenmarkt—Lichtenfelt, coals			7,653	45.0	4,767	37	5,519	27	10					
H	Stockheim—Hochstadt, coals	650	6.7	3,786	41.1	2,094	44	2,531	32	12	44.0	0.69	268.4	4.29	6.71
	Hochstadt—Stockheim, coals	980	6.0	5,258	37.1	3,544	32	3,986	26	6	59.4	0.94	364.1	5.72	6.71
	Stockheim—Hochstadt, coals	.....	....	3,389	40.0	2,150	38	2,362	30	8	.....	.....	.....	.....	.....